



Investigating a reading comprehension intervention for high school students with autism spectrum disorder: A pilot study



Colleen K. Reutebuch*, Farah El Zein, Min Kyung Kim, Aron N. Weinberg, Sharon Vaughn

The Meadows Center for Preventing Educational Risk, College of Education SZB 228, The University of Texas at Austin, 1912 Speedway D4900, Austin, TX 78712-1284, USA

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ABSTRACT

We adapted and piloted Collaborative Strategic Reading–High School, a reading comprehension intervention, with three high school students with autism spectrum disorder to investigate its effects on their reading comprehension. Using a nonconcurrent, multiple-baseline design, participants with autism spectrum disorder were paired with a neurologically typical (neurotypical) reading partner to learn and use reading strategies with informational text two to three times per week. Daily comprehension checks were collected and visually inspected for trends along with data on the number of challenging behaviors and social interactions displayed during intervention. Fidelity of implementation was also measured. Though exploratory, increases in comprehension and interactions were noted along with decreases in challenging behaviors. Implications for practice and research are discussed.

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1. Introduction

Previous research has indicated that students with autism spectrum disorder (ASD) may have challenges with literacy skills, particularly with reading comprehension (O'Connor & Hermelin, 1994; O'Connor & Klein, 2004). Many students with ASD exhibit strengths in basic reading skills (i.e., word recognition) coupled with difficulties in reading comprehension (Chiang & Lin, 2007; Nation, Clarke, Wright, & Williams, 2006; O'Connor & Hermelin, 1994; Patti & Lupinetti, 1993; Smith Myles et al., 2002). Even among students with ASD who can read accurately, levels of reading comprehension are generally poor (Frith & Snowling, 1983; Minshew, Goldstein, Taylor, & Siegel, 1994; O'Connor & Klein, 2004; Snowling & Frith, 1986). Currently, reading comprehension is identified as the most prevalent area of weakness in academic achievement of students with ASD (Jones et al., 2009).

Researchers have suggested possible underlying factors that may contribute to deficits in reading comprehension. One explanation is that students with ASD are less likely than their typically developing peers to use applicable cues that would aid in effectively making connections between main ideas that are represented in a text (Flores & Ganz, 2007; O'Connor & Klein, 2004). Deficits in the development of certain language skills may occur, particularly comprehension of higher-level, complex discourse, affecting the reading comprehension of individuals with ASD. Additionally, some researchers have proposed that these difficulties may be attributed to the challenging behaviors many of these students develop (Browder & Spooner, 2006; Fox, Dunlap, & Buschbacher, 2000; Machalicek, O'Reilly, Beretvas, Sigafoos, & Lancioni, 2007) and to their

* Corresponding author. Tel.: +1 512 232 1218.

E-mail address: ckreutebuch@austin.utexas.edu (C.K. Reutebuch).

difficulties in forming appropriate relationships with teachers and peers (Machalicek et al., 2008; Ramdoss et al., 2011). Along the same lines, repetitive behaviors and interests are commonly described as possible factors contributing to difficulties in academic learning (Jones et al., 2009).

Although evidence-based instructional approaches that target literacy have proven to be successful with many struggling learners, we still face the challenge of finding targeted interventions to meet the needs of students who do not respond to current evidence-based practices (Al Otaiba & Fuchs, 2002). Inadequate research exists on effective reading comprehension instruction for students with ASD, and teachers repeatedly communicate that they are uncertain how to effectively teach these students to read for meaning (Chiang & Lin, 2007). The use of specific evidence-based interventions validated effective for students with ASD could enhance students' academic outcomes in the area of reading comprehension (Chiang & Lin, 2007; Zein, Solis, Vaughn, & McCulley, 2013).

1.1. Previous research on reading instruction with high school students with ASD

Previous interventions targeting students with ASD have focused on challenging behavior and communication skills while neglecting areas of academic underachievement such as reading comprehension (El Zein et al., 2013). Syntheses of reading interventions for students with ASD found research in this area lacking, particularly for those in secondary grades. Relatively few reading intervention investigations have focused on reading comprehension relative to those that focus on sight word recognition, decoding skills, and fluency (Chiang & Lin, 2007; El Zein et al., 2013; Whalon, Al Otaiba, & Delano, 2009; Whalon & Hanline, 2008).

For students with ASD, effective reading intervention in high school may be essential to developing reading skills prior to entering postsecondary life (e.g., college, career). Acquiring adequate reading comprehension skills is necessary for successful learning in any subject area as well as for improving students' quality of postsecondary life (Carnahan & Williamson, 2010). However, the great cognitive heterogeneity within ASD leads to unique challenges in comprehending text that have not been addressed for secondary students with ASD at the high school level (El Zein et al., 2013).

1.2. Overview of collaborative strategic reading

Collaborative strategic reading (CSR) is rooted in cognitive psychology (Flavell, 1979; Palincsar & Brown, 1984) and sociocultural theory (Pérez, 1998; Vygotsky, 1978). It teaches students to apply metacognitive and cognitive strategies for improving comprehension. The reader is taught metacognitive strategies that are involved in monitoring understanding, selecting what to remember, and regulating strategy use (Flavell, 1979). The cognitive strategies involved in traditional CSR include previewing text, clarifying unknown words, determining main ideas, and generating questions about and summarizing what has been read (Vaughn et al., 2013).

CSR combines strategy instruction and cooperative learning (Klingner & Vaughn, 1996). It is a fully developed, evidence-based instructional approach to reading comprehension that has been evaluated through numerous quasi-experimental and experimental studies, most recently with two randomized controlled trials (Vaughn et al., 2011, 2013). Prior studies that implemented traditional CSR have demonstrated improved reading outcomes for students with learning disabilities and for students at risk for reading difficulties, including English learners (Bryant et al., 2000; Klingner, Vaughn, & Schumm, 1998; Vaughn, Hughes, Moody, & Elbaum, 2001; Vaughn et al., 2000, 2011, 2013). Although CSR may hold promise for students with ASD, it has not yet been investigated specifically with this population in a secondary setting.

1.3. Adapting CSR for high school students with ASD

Prior to the pilot study, we conducted focus groups with parents and educators and met with content area teachers to gain perspective on the proposed use of CSR in high school with higher-functioning students with ASD. It is important to acknowledge that the adapted version of CSR is not appropriate for all students with ASD across the spectrum. Rather, the adaptations were added to support students with high-functioning autism—that is, those deemed to have higher cognitive functioning and the ability to read with some understanding but who struggle with reading comprehension. Those with high-functioning autism often spend the majority of their school day mainstreamed and are expected to be successful with a more academic-focused curriculum than that of students with ASD who have higher support needs.

From the focus groups came a call for a reading comprehension intervention that could be generalized for use across reading topics and classes and that would have broad appeal to students and educators. Subsequently, traditional CSR underwent several adaptations. The lead investigators—both experts in traditional CSR and reading intervention along with a group of doctoral students, all experienced special educators—worked together to incorporate evidence-based practices specific to ASD (e.g., priming, prompting, self-monitoring). Structure was added for teachers and peer partners, including preteaching related to the topic, concept, and vocabulary; specific monitoring and question prompts; and a graphic organizer to aid in summary development. What resulted is Collaborative Strategic Reading–High School (CSR–HS), a version of CSR that could be implemented in content area settings to support reading for meaning or as a supplemental intervention to develop students' reading comprehension in settings such as resource rooms, studies

skills classes, or remedial classes. CSR–HS retains CSR’s package of components to help students become more strategic when engaging with text before, during, and after reading. However, strategies are made more explicit and use is streamlined to better complement instructional activities already in place (see full description of strategies in Fig. 1 and in Section 2.8.4).

1.4. Purpose of this study

The educational community is faced with the challenge of finding targeted reading interventions to meet the needs of students who do not respond to current evidence-based practices, including students with low-incidence disabilities (Vaughn & Fletcher, 2012). However, syntheses of research on reading comprehension intervention for students with ASD suggest that reading interventions that have been identified as beneficial for struggling readers without ASD may be promising for students with ASD (Chiang & Lin, 2007; El Zein et al., 2013; Whalon & Hanline, 2008). El Zein et al. synthesized more than 20 years of research on reading comprehension intervention for students with ASD and found that strategy instruction and student grouping practices such as cooperative learning are promising approaches to improving reading comprehension outcomes in this population.

The purpose of our investigation was to pilot the use of CSR–HS and to document subsequent changes in reading comprehension. Although our aim was to target improvements in reading, our participating students with ASD also displayed challenging behaviors that impeded their ability to participate in and complete academic tasks. Additionally, all three students had very limited social interactions with peers and adults. Therefore, for descriptive purposes, we also collected data on the frequency of these occurrences when engaged in treatment. Though our current investigation did not demonstrate a functional relationship between reading, challenging behaviors, and social interaction, we believe this is an area for further and more thorough exploration in the future.

2. Methods

We conducted an exploratory pilot study in a central Texas high school, using a delayed-multiple-baseline design with three students with ASD. Due to the collaborative nature of the intervention, targeted students were paired with neurologically typical (neurotypical) teens selected for participation by a campus administrator. These peer partners were academically advanced and good-natured students who were available and willing to serve on the project. No data were collected on the neurotypical peers. Permission from neurotypical student partners and their parents was obtained prior to the start of the intervention.

The only available period for pairs to work together was during a 30-min school-wide advisory period. Partners met in a portable classroom normally reserved for students with ASD and the staff members who supported them throughout the school day. Target students with ASD reported to the portable classroom for an advisory period to check in with the staff members assigned to monitor them and their work.

Due to a lack of available school staff members during this time period, two trained graduate students implemented the intervention sessions. Due to limited space and volunteers to serve as peer partners, we could not run sessions concurrently. School administrators approved intervention to be conducted only during a daily advisory period, which further inhibited our experimental control. Researchers implemented the reading comprehension intervention for approximately 16 weeks with each of the three targeted students with ASD.

In addition, tutoring sessions with each target student and the intervention implementers were conducted once a week during the students’ study skills period, a regularly scheduled 50-minute class conducted in a portable classroom. Focus group members recommended and school staff insisted that tutorials be offered in addition to the intervention sessions. During this time, the interventionist and student with ASD met to review the previous intervention sessions and CSR–HS strategies. Some of these tutorials also focused on priming the target student—that is, practicing the skills necessary to work cooperatively with a partner (e.g., making eye contact, initiating appropriate conversation, asking for help).

2.1. Selection criteria

Three adolescents with ASD were targeted for intervention. Inclusion was mainly based on convenience—specifically, that students met minimal eligibility requirements and were available and willing to participate. Eligibility for inclusion in our study included: (a) enrollment in high school, (b) age between 13 and 22, (c) identification as receiving special education support under an educational or psychiatric diagnosis of an ASD (autism, pervasive developmental delay—otherwise specified, or Asperger syndrome), (d) reading on a least a second-grade instructional level with an IQ in the low-average to above-average range (80 and above), and (e) receiving instruction primarily in academic content throughout the school day in inclusive settings. Researchers met with a district special education staff member to review inclusion criteria for participants in the study and assess district records of potential participants (all identifying information redacted). Potential participants who met these criteria were then selected for inclusion in the study. District representatives made initial contact with parents of these candidates. Parental consent and student assent were received for all study participants.

CSR–HS STRATEGIES GUIDE

Rationale

Develop skills for enhancing comprehension of informational text by using strategies before, during, and after reading

Standards

- Know and use various text features to locate key facts or information in a text.
- Ask and answer questions about key details in a text.
- Identify the main topic and retell key details of a text.
- Ask and answer questions to determine or clarify the meaning of words and phrases in a text.

Preparation

Before introducing any Collaborative Strategic Reading – High School (CSR–HS) lesson, establish pairs and set expectations:

- Pair students with heterogeneous skills and abilities.
- Establish expectations for paired work, so that all

students contribute and work cooperatively with one another; set expectations for reading; and set expectations for student engagement.

- Invite students to contribute examples and non-examples of expected behavior during CSR–HS work groups.

Student Materials

- One per student:
 - Text with key words
 - Learning log
 - Writing utensil
- One per pair:
 - Checklist with discussion prompts
 - CSR–HS graphic
 - Question stems

Teacher Materials

- Lesson plan
- Illustration
- Timer
- Learning log evaluation rubric

Teacher Introduction 2 to 3 minutes

The following activities are recommended during this phase:

- Have materials ready and organized.
- Ensure pairs are in place and prepared for CSR–HS.
- Communicate expectations by providing clear, explicit indications of goals for assignments and activities.
- Provide explicit instruction for the assignment and activities.

Before Reading 2 to 3 minutes

To prepare students for reading, the following activities are recommended:

- Introduce the topic.
- Preteach key words and/or proper nouns.
- Build background knowledge or connect to students' prior knowledge (e.g., through pictures, videos, demonstrations).
- Set the purpose for reading.
- Have students write key words in their learning logs.

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During Reading 10 to 12 minutes

This phase requires **students** to do the following:

- Read the assigned text, stopping when words or phrases do not make sense.
- Answer true-or-false questions, which will help you monitor their comprehension.

Monitor as students "**fix-up**" meaning:

- Check whether students identify and record words, phrases, or sentences from the text that they do not understand.
- Provide verbal prompts for students who struggle.
- Provide examples (i.e., pieces of text you expect to be difficult to comprehend) for students who continue to struggle.

Monitor as students complete the **true/false activity**:

- Check whether students stop at the predetermined places.
- Check whether students answer and briefly discuss the statements.
- Check whether students continue reading after discussing a statement.
- If a statement is false, help students figure out why.

After Reading 10 to 12 minutes

Students review the important ideas they have learned through two steps:

- Generating and discussing questions with their partner
- Summarizing what they just read, using a graphic organizer

Monitor as students **generate and answer questions**:

- Remind students to use question stems.
- Check whether students share their questions and answers with their partner.
- Scaffold difficult questions.
- Help students who struggle to create questions by brainstorming with the students or offering question stems.

Monitor as students use the **graphic organizer**:

- Explain how to use clues to identify the most important "who" or "what."
- Check whether students identify the most important information about the "who" or "what."
- Check whether students write two to three sentences about the topic.
- Check whether students write individual summaries.

Conduct **wrap-up**:

- Restate the purpose of the day's reading.
- Remind students of what they were able to accomplish during the session.
- Provide brief feedback about student performance and behavior during the lesson.

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Fig. 1. CSR–HS strategies guide.

2.2. Participants

Participating students with ASD and the setting are described below. See Table 1 for a summary of participant characteristics.

2.2.1. Hector

“Hector” was a 15-year-old Hispanic/Latino male in ninth grade who read at a third-grade instructional level on the informal reading assessment and scored a grade equivalent of 2.0 on the passage comprehension subtest of the Woodcock-Johnson Tests of Achievement III (WJIII; Woodcock, McGrew, & Mather, 2001). At age 3, he received a primary diagnosis of autism from a neurologist. The instructional staff, including a behavioral specialist, reported that Hector easily fell off task, sought attention in inappropriate ways during class periods, and rocked in his chair when he felt anxious. A paraprofessional provided Hector with support during some of his classes, including reading assigned texts to him aloud. Hector was described as often engaging in off-task behaviors. He attended to many things but had a hard time focusing his attention on instruction. Hector was enrolled in mostly inclusion settings with English and study skills in a resource setting for students with disabilities. Although he was noted to be social and cooperative, he was observed as working in isolation in his classes or solely with the assistance of a paraprofessional.

2.2.2. Brian

“Brian” was a 16-year-old male in the 10th grade identified as both Hispanic/Latino and Caucasian. He read at a second-grade instructional level on a published informal reading assessment and a K-8 on the WJIII test of reading comprehension. At age 3, a psychiatrist assigned Brian a primary diagnosis of autism and a secondary diagnosis of speech impairment. An assistant or student peer sometimes provided Brian with academic and behavioral support in his classes. According to school staff, Brian did not participate during class periods. The researchers observed peers being assigned to help Brian with assigned classwork, but he continually refused to work with others or on assigned tasks. Sometimes, he was allowed to work on origami or to play a game on a computer tablet during instructional activities.

2.2.3. Sofia

“Sofia” was a 17-year-old girl in the 11th grade identified as Hispanic/Latina. She received a primary diagnosis at age 7 of Asperger’s and secondary diagnoses of anxiety disorder and attention deficit hyperactivity disorder from a neurologist. Her instructional reading level was at the fifth grade and her passage comprehension grade-equivalent score on the WJIII was 4.8. She did not receive any support from an assistant. According to her teachers, she did not generally participate in classroom reading activities. Although she did not speak to peers during class periods, she did contribute to class discussions without prompting. Sofia was observed as appearing very agitated during general education class sessions, particularly if she was not assigned a task (e.g., writing, watching a video). She often engaged in skin picking, particularly to her scalp, to the point where she drew blood and created bald spots.

2.3. School and setting

The study was conducted in a rural school district in Central Texas. Within this district, 65% of the school population was economically disadvantaged and 50% of the students were of Hispanic/Latino origin. Implementation of the intervention occurred in a high school with an enrollment of more than 1700 students. The high school served students identified with ASD in a variety of educational settings: (a) self-contained; (b) partially inclusive with some resource, life skills, or functional supports provided; and (c) fully inclusive within the general education setting. All phases of the study were conducted at a table in a portable classroom designated for use by students with ASD and support personnel. Students with ASD reported to

Table 1
Participant characteristics.

Student	Age	Grade	Diagnoses (primary/secondary)	Ethnicity	Instructional reading level (GE)	WJIII PC pretest (GE)	WJIII PC posttest (GE)	Challenging behavior and recording method
Hector	15	9	Autism	Hispanic/Latino	3.0	2.0	2.1	Off task Partial interval recording
Brian	16	10	Autism	Hispanic/Latino/ Caucasian	2.0	K-8	1.4	Noncompliance Event recording
Sofia	17	11	Speech impairment Asperger’s anxiety disorder ADHD	Hispanic/Latina	5.0	4.8	7.9	Skin picking and rubbing Partial interval recording

Note. GE = grade equivalent; WJIII PC = Woodcock Johnson III passage comprehension subtest; ADHD = attention deficit hyperactivity disorder.

this portable classroom daily for an advisory period and throughout the day for scheduled study skills classes, during which students worked independently or with guidance from a teaching assistant. Students also used this time to read, use the computer, or prepare for upcoming tests and assignments.

2.4. Materials

Materials for each session included the following: (a) lesson plan; (b) assigned text for student reading; (c) checklist for students to use to monitor the completion of tasks; (d) learning logs for students to complete, which included activities for promoting and monitoring comprehension of texts; (e) reading comprehension probes; (f) data sheets for recording the incidence of social interactions and challenging behavior of target students; (g) data sheets and rubric for recording the fidelity of the intervention's implementation; (h) timer; and (i) writing instruments. All written materials except for the assigned text and comprehension questions were researcher developed. Instructional grade-level text and corresponding comprehension questions were selected from published Read Naturally passages that included grade-level, expository, high-interest text of about three to four paragraphs each.¹ Topics of the passages were animals, historic figures, and mysterious events. The reading passages have previously been used to validate a computer-assisted version of CSR (Kim, Vaughn, Klingner, Reutebuch, & Kouzekanani, 2006). Due to the short duration of intervention sessions, comprehension probes were limited to four multiple-choice questions meant to capture recall of main ideas and facts from the text. These probes were intended to mimic comprehension probes that content area teachers use and that often accompany text in adopted textbooks used in science, social studies, and English language arts classrooms. Furthermore, each partner independently recorded information on a learning log, although pairs were encouraged to work in partnership to verify the accuracy of their responses.

2.5. Dependent variables

During baseline and intervention phases, data were collected on the following dependent variables: (a) accuracy of responding, (b) challenging behaviors, and (c) social interactions. Implementers recorded accuracy of responding by reviewing completed learning logs and comprehension probes. Data collectors coded instances of social interaction and challenging behaviors observed during sessions across all phases.

2.5.1. Accuracy of responding

Accuracy of responding was calculated as the percentage of correct multiple-choice responses to reading comprehension questions that were administered to all participants at the end of each session.

2.5.2. Social interaction

Social interactions were defined as student initiations and responses (Dugan, Kamps, & Leonard, 1995). Initiations, in turn, were defined as motor or vocal behavior (e.g., assisting, sharing materials, conversing) clearly directed to a peer to evoke a response. Responses were defined as motor or vocal behavior in reply to the initiation within 3 s of the initiation behavior. Event recording was used to collect data on initiations and responses for each of the three target participants.

2.5.3. Challenging behavior

Challenging behavior was operationally defined on an individual basis, depending on the behavior of interest for each student. Behaviors were identified through direct observation and interviews with the target students, the teachers of target students, and a behavior specialist at the school where the study was implemented.

Hector's challenging behavior was identified as falling off task, which was documented by using partial interval recording during study sessions. Off-task behavior was defined as the occurrence of any of the following behaviors: (a) leaving his seat, (b) looking away from a speaker (i.e., implementer or peer) or material for longer than 3 s, (c) engaging in an activity that was irrelevant to the assigned task, and (d) participating in a conversation or asking a question that was irrelevant to the topic of the reading. Brian's challenging behavior was noncompliance. Noncompliance, measured by using event recording, was defined as refusal to engage in a task within 5 s of the implementer's request. Sofia's challenging behavior was skin picking. Partial interval recording was used to measure the incidence of scratching, picking, rubbing, or squeezing any area of the skin (e.g., face, arm, neck, scalp).

2.6. Independent variable

The independent variable in this study was CSR–HS, a multicomponent reading comprehension intervention with a cooperative learning feature that was modified for high school students with ASD. The intervention includes strategies and

¹ The Read Naturally materials used the following readability formulas to level reading passages: (a) Fry and Spache readability formulas for levels 0.8–2.7, (b) Harris–Jacobson readability formulas for levels 3.0–5.0, and (c) Dale Chall readability formulas for levels 5.6 and above. According to the Read Naturally teacher's guide, the reading levels correspond to grade levels in that the readability score for each passage at each level falls within three-tenths of the grade level named.

activities that are used before, during, and after reading to activate students' background knowledge, increase text engagement, and monitor reading progress and comprehension.

2.7. Design

A delayed multiple-baseline repeated-measures design was employed across participants. Multiple-baseline designs are well suited to the practical requirements of reading intervention research and do not require a return to baseline to demonstrate experimental control (Kucera & Axelrod, 1995). Furthermore, repeated-measures designs allow for “deductions to be drawn from a pattern of behavior,” rather than from a single probe of each participant, which may yield more variable data that are less representative of actual levels of performance (Neuman & McCormick, 1995, pp. 7–8).

2.8. Intervention procedures

Treatment sessions were conducted for 30 min with each target student or peer pair during an advisory period. The intervention occurred two to three times per week over an approximately 16-week period. Members of the research team provided all implementation.

2.8.1. Overview procedures

The training session, conducted one on one with the implementer prior to the treatment phase, provided each student with ASD with an opportunity to learn the steps of CSR–HS as well as the rules and expectations to follow during future sessions. A second training session was conducted with each student with ASD and his or her peer partner prior to the implementation of the treatment phase to review the procedures and expectations and to establish and build rapport with the partners and with the implementer.

2.8.2. Baseline procedures

During baseline, each student with ASD participated in one-on-one sessions with the implementer. These sessions used “business-as-usual” instruction to simulate the reading tasks that students were typically asked to perform independently across content areas. Students read instructional-grade-level-appropriate passages either silently or aloud. The implementer provided directions for responding to reading comprehension questions, which were answered by each the participant upon the completion of the reading activity without the benefit of prompting or error correction from the implementer. Once a stable baseline performance (i.e. at least three consistent data points) had been established for Hector, he began the treatment condition (i.e., CSR–HS), and Brian commenced the baseline condition. The same baseline and treatment protocol was followed for Brian and Sofia. We believe the instability of data points during baseline demonstrated a clear need across students to move into treatment. Variability was an indication that students did not possess the skills to read strategically for meaning.

2.8.3. Individual tutoring

During the intervention phase, each participant with ASD received one-on-one tutoring sessions with the implementer. These sessions were conducted for 20 to 30 min once per week during each student's scheduled study skills period, which students attended daily for 50 min. The sessions provided each student with guided practice of prerequisite skills for future sessions and review with feedback on completed learning logs from previous sessions.

2.8.4. CSR–HS intervention procedure (treatment phase)

During the intervention sessions, each student with ASD worked collaboratively with a typically developing peer whose teachers and campus administrator identified as working well with the target student. A minimum of three consistent data points was required for each target student to transition to the subsequent phase of the study.

2.8.4.1. Before reading. The before-reading phase consisted of a teacher-led strategy used prior to reading a designated text. The implementer followed four steps to introduce the text material and help the peer pair connect reading material with previous background knowledge: (a) provided a brief statement about the purpose of the day's reading and the tasks for students to complete; (b) prompted students to scan the title, headings, pictures, and charts or tables in the selection; (c) introduced two to three key vocabulary terms from the selection; and (d) supplemented written text with a visual display (e.g., picture, demonstration, short video clip). Students recorded and defined the key vocabulary words in their learning logs.

2.8.4.2. During reading. During the reading of the assigned text, the peer pair completed two activities, which were recorded in their respective learning logs. First, the pair discussed any portions of the text that one or both of the students did not understand and then “fixed” the text by rewriting these portions in their own words. Second, the pair was prompted at predetermined places within the text to respond to true or false statements about information in the text. Each student was required to justify his or her true or false response to his or her partner.

2.8.4.3. After reading. After reading, the peer pair reviewed important ideas that had been learned and recorded responses in their learning logs. This phase consisted of four tasks. First, the pair generated, discussed, and answered questions about the text. Second, the students identified the most important “who” or “what” from the completed reading. Third, each student independently completed a summary of the reading. Fourth, each student independently answered multiple-choice comprehension questions about the text. The after-reading portion concluded with a teacher-led wrap-up, which consisted of restating the purpose of the session’s reading and reviewing the tasks that students had completed during the session.

2.8.5. CSR–HS 2 intervention procedure (treatment phase)

Brian expressed distress at being paired with a female partner and did not appear to benefit from working collaboratively with her. Therefore, the research team determined that he would be best served by a modified CSR–HS phase, CSR–HS 2. During this phase, the target student worked only with the implementer, a male who had established a good relationship with Brian and who served as his partner. Several additional modifications to the intervention were made. First, additional prompting during the reading of assigned text was included. Second, oral instead of written responses were used to complete tasks in the learning logs. Third, positive reinforcement in the form of access to a preferred game on an iPad was delivered at the end of each successfully completed session. The implementation of CSR–HS 2 occurred over five sessions.

2.8.6. Maintenance and independent reading procedures

One week after discontinuing CSR–HS, maintenance data were collected for Hector and Sofia by using the same peer pairing and recording systems followed during the baseline and intervention phases. Brian progressed to the maintenance phase after completing CSR–HS 2, although he continued to work one on one with his implementer. After three consistent data points were established for Hector and Sofia during the maintenance phase, these students proceeded to an independent reading phase, during which they read assigned texts, completed learning logs, and answered comprehension questions without the aid of either the implementer or peer partner. Brian was not introduced to the independent reading phase. At least two consistent data points were required for each student during this last phase of the intervention.

2.9. Measures

2.9.1. Academic testing

The passage comprehension subtest of WJIII was administered to the participants preintervention and postintervention for descriptive purposes only. Internal consistency reliability is .80. Internal consistency is reported as .95. We have administered this reading comprehension test in previous studies. Read naturally placement materials were used to select the appropriate instructional level of text for each student to use throughout all phases of the intervention. Trained staff members who were not part of the intervention implementation administered academic testing.

2.9.2. Read naturally multiple comprehension probes

Each story includes eight probes that consist of five common types of comprehension questions: main idea, literal, vocabulary, inferential, and short answer. Due to limited time during the treatment sessions, we eliminated open-ended, matching, and fill-in-the-blank responses, so that questions pertained solely to identification of the main idea, recall of facts, and use of context to determine meaning. No reliability or validity information is available from the publisher on the comprehension probes that accompany passages meant for building and assessing reading fluency.

2.10. Fidelity

A research team member who was not an implementer collected fidelity of implementation data for 100% of the baseline, intervention, maintenance, and independent phases. A detailed rubric was used to measure the fidelity of the intervention’s implementation for each session. Fidelity scores recorded the degree of alignment of the intervention with CSR–HS (procedural fidelity) during the following phases: teacher introduction, before reading, during reading, and after reading. The global quality of the intervention was also scored. For the fidelity of implementation measure, a second independent observer collected data for 40% of the sessions for the three participants. Fidelity rubric scores were compared and mean agreement was calculated by using the same formula described above. Mean agreement for the fidelity measure was 98% for Hector, 94% for Brian, and 100% for Sofia.

2.11. Interobserver agreement

A second independent observer collected data on reading comprehension probes for 40% of all sessions for the three participants. Agreement data were calculated on an item-by-item basis. An agreement was defined as both observers rendering an identical score for a probe item. Percentage agreement for each probe was calculated by dividing the number of agreements across probe items by the number of agreements plus disagreements and then multiplying the resulting number by 100 to convert the result to a percentage. Mean agreement was 100% for the three participants. For challenging behavior and social interaction data, a second two observers simultaneously collected data during 30% of sessions for the three participants. Interobserver agreement was calculated by using interval-by-interval comparisons. The number of intervals in

agreement was summed, divided by the total number of intervals for the session, and multiplied by 100 to convert the result to a percentage. Mean agreement for challenging behavior was 94% for Hector and 96% for Brian and Sofia. Mean agreement for social interaction was 91% for Hector, 94% for Brian, and 93% for Sofia.

2.12. Data analysis

Researchers have traditionally used the visual analysis method to interpret single-case study results (Horner et al., 2005; Kennedy, 2005; Kratochwill et al., 2013). Currently, there does not seem to be a consensus regarding one statistical analysis procedure to interpret results from single-case design studies (Kratochwill et al., 2010, 2013). For these reasons, we analyzed data based on visual inspection of the graph for each dependent variable. Visual inspection of the graphs was based on the (a) level, (b) trend, (c) variability, (d) overlap, (e) immediacy of the effect, and (f) consistency of data patterns across similar phases (Kratochwill et al., 2010, 2013).

3. Results

3.1. Reading comprehension

3.1.1. Hector

Hector's accuracy of responding to reading comprehension probes had a mean of 40% during baseline. His mean score increased to 81% during the CSR–HS intervention phase. Visual analysis of his reading comprehension graph showed an immediate increase in scores upon implementation of CSR–HS. Hector continued to show increases in reading comprehension scores during the maintenance and independent phases. Hector's mean scores were 94% during the maintenance condition and 92% during the independent condition. During baseline, Hector's scores on reading comprehension probes ranged from 25% to 75%, with 25% being the most frequent score. His scores during CSR–HS intervention phase varied from 50% to 100%, with 100% being the most frequent score. During the maintenance and independent phases, his scores ranged from 75% to 100%, with 100% being the most frequent score. Variability in scores was considerably higher during baseline than during the CSR–HS, maintenance, and independent phases. Additionally, visual inspection of Hector's reading comprehension graph reveals clear ascending trends during the intervention, maintenance, and independent phases.

3.1.2. Brian

Brian's accuracy of responding to reading comprehension probes had a mean of 60% during baseline. His mean score dropped to 33% during the CSR–HS intervention phase. Brian demonstrated an increase in reading comprehension scores during the second intervention phase (CSR–HS 2). Brian's maintenance scores demonstrated consistency at 75%. During baseline, Brian's scores on reading comprehension probes ranged from 25% to 100%, with 50% being the most frequent score. His scores during the CSR–HS intervention phase varied from 0% to 50%, with 50% being the most frequent score. His scores were consistently 75% across maintenance sessions. Variability in Brian's scores was dramatically higher during baseline and the CSR–HS phase than during the CSR–HS 2 and maintenance phases. Additionally, visual inspection of Brian's reading comprehension graph revealed an overall increase in accuracy of responding to reading comprehension probes upon introduction of CSR–HS 2.

3.1.3. Sofia

Sofia's accuracy of responding to reading comprehension probes had a mean of 60% during baseline. Her mean score increased to 88% during the CSR–HS intervention phase. Sofia continued to show increases in reading comprehension scores during the maintenance and independent phases. Sofia's mean scores were 92% during the maintenance condition and 100% during the independent condition. During baseline, Sofia's scores on reading comprehension probes ranged from 25% to 100%, with 50% being the most frequent score. Her scores during the CSR–HS intervention phase varied from 50% to 100%, with 100% being the most frequently observed score. During the maintenance phase, her scores ranged from 75% to 100%, with 100% being the most frequent score. Sofia demonstrated consistent scores of 100% across independent sessions. Variability in Sofia's reading comprehension scores was considerably higher during baseline than during the CSR–HS, maintenance, and independent phases. Additionally, visual inspection of Sofia's reading comprehension graph revealed clear ascending trends from CSR–HS to the independent phase.

3.2. Challenging behavior

3.2.1. Hector

During baseline, Hector engaged in off-task behavior on an average of 96% of the intervals. The majority of his baseline sessions (80% of the sessions) demonstrated occurrences of a minimum of one incident of off-task behavior during 100% of the observed intervals. Hector's levels of off-task behavior gradually decreased upon implementation of CSR–HS, dropping from 100% to 43% of intervals. Percentage of Hector's off-task intervals continued to drop during the maintenance phase (mean of 14%) and independent phase (mean of 2%) until it reached 0% at the end of the independent phase. Variability within

Hector's challenging behavior data was markedly higher during baseline than during the CSR–HS, maintenance, and independent phases. Visual analysis of Hector's challenging behavior graph revealed a steep downward trend, demonstrating a dramatic decrease in off-task behavior occurrences during the CSR–HS, maintenance, and independent phases.

3.2.2. Brian

During baseline, Brian engaged in task refusal behavior on an average of 33% of the intervals. Brian's levels of task refusal gradually decreased upon implementation of CSR–HS, dropping from 33% to 9% of observed intervals. During CSR–HS 2, no task refusal intervals were observed (0% intervals). The percentage of Brian's task refusal intervals remained at 0% during the maintenance phase. Variability within Brian's challenging behavior data was considerably higher during baseline than during the intervention and maintenance phases. Visual analysis of Brian's challenging behavior graph revealed a steep downward trend, demonstrating a dramatic decrease in task refusal occurrences from baseline to the CSR–HS, CSR–HS 2, and maintenance sessions.

3.2.3. Sofia

During baseline, Sofia engaged in skin picking behavior on an average of 90% of the intervals. The majority of her baseline sessions (about 60% of the sessions) demonstrated occurrences of a minimum of one incident of skin picking behavior during 100% of the observed intervals. Sofia's levels of skin picking behavior decreased immediately upon implementation of CSR–HS (mean of 36%), dropping from 100% to 35% of intervals. Percentage of Sofia's skin picking intervals continued to drop during the maintenance phase (mean of 3%) until it reached 0% during the independent phase. Variability within Sofia's challenging behavior data was considerably higher during baseline than during the CSR–HS, maintenance, and independent phases. Visual analysis of Sofia's challenging behavior graph revealed a steep downward trend, demonstrating a dramatic decrease in skin picking occurrences upon introduction of CSR–HS.

3.3. Social interactions

3.3.1. Hector

During baseline, Hector's frequency of social interactions (i.e., initiations and responding) was fewer than 10 incidences per session. Upon implementation of CSR–HS, an immediate increase in social interactions was observed. This increase continued during the maintenance phase, and even though a decrease was noticed during the independent phase, incidences of social interactions were consistently higher compared to baseline (Figs. 2 and 3).

Frequencies of social initiations for Hector are represented in Fig. 4. Visual inspection of the graph reveals an immediate increase in the level of social initiations upon implementation of CSR–HS. The level of social initiations rose from baseline (mean of 3) to the intervention phase (mean of 28), continued to rise during the maintenance phase (mean of 61), and slightly decreased during the independent phase (mean of 51).

Similar changes in frequencies were observed for the social responding dependent variable. Visual analysis of the social responding graph (Fig. 5) reveals an immediate increase in the level of social responding from baseline (mean of 2) to the intervention phase (mean of 10). This increase continued during the maintenance phase (mean of 19) and dropped during the independent phase (mean of 9), which was still higher compared to baseline.

3.3.2. Brian

During baseline, Brian's frequency of social interactions (i.e., initiations and responding) ranged from zero to five incidences per session. Upon implementation of CSR–HS, an immediate increase in social interactions was observed. This increase continued during the maintenance phase, and even though a decrease was noticed during the independent phase, incidences of social interactions were consistently higher compared to baseline.

Frequencies of social initiations for Brian are represented in Fig. 4. Visual inspection of the graph reveals an immediate increase in the level of social initiations upon implementation of CSR–HS. The level Brian's social initiations remained the same from baseline (mean of one) to the CSR–HS phase (mean of two). The level of social initiations increased immediately upon implementation of CSR–HS 2 (mean of 44). Visual analysis of Brian's graph reveals that his level of social initiations stayed relatively high during the maintenance phase (mean of 16).

Similar changes in frequencies were observed for Brian's social responding dependent variable. Visual analysis of his social responding graph (Fig. 5) reveals an immediate increase in the level of social responding from baseline (mean of 3) to CSR–HS 2 (mean of 44). This increase continued during the maintenance phase (mean of 26).

3.3.3. Sofia

During baseline, Sofia's frequency of social interactions (i.e., initiations and responding) was lower than 10 incidences per session. Upon implementation of CSR–HS, an immediate increase in social interactions was observed. This increase continued during the maintenance phase, and even though a decrease was noticed during the independent phase, incidences of social interactions were consistently higher compared to baseline.

Frequencies of social initiations for Sofia are represented in Fig. 4. Visual inspection of the graph reveals an immediate increase in the level of social initiations upon implementation of CSR–HS. The level of social initiations rose from baseline (mean of 5) to the intervention phase (mean of 34) and stayed relatively high during the maintenance phase (mean of 33).

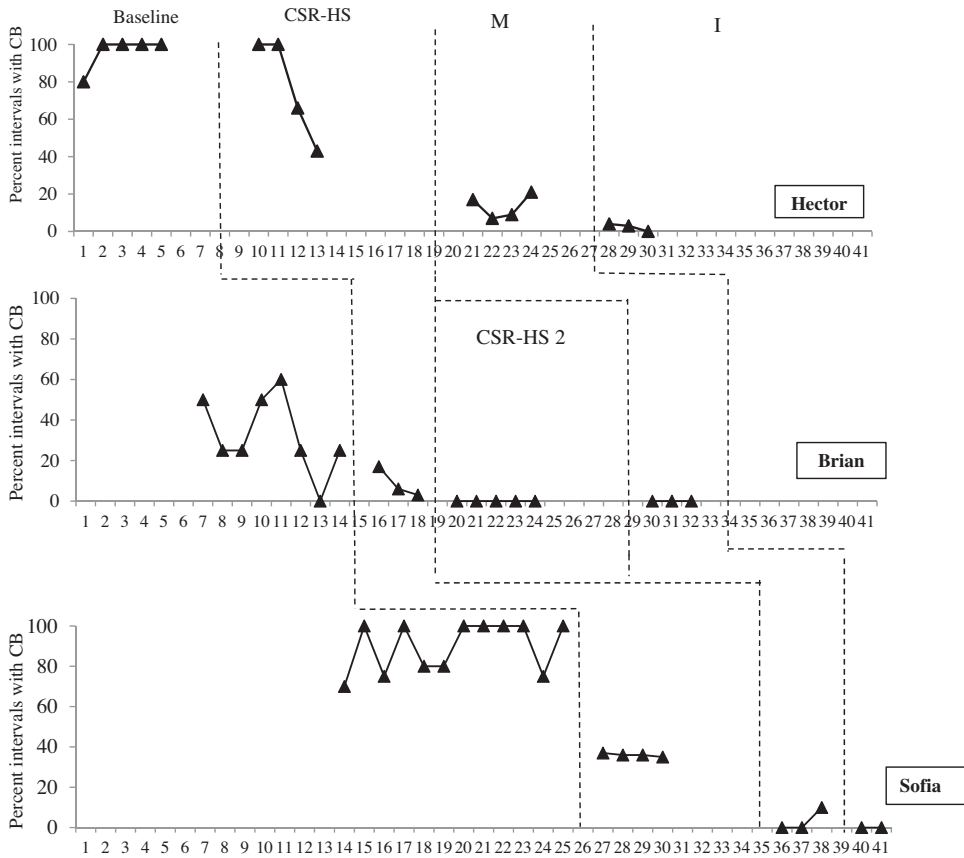


Fig. 2. Percent correct: Reading comprehension probes.

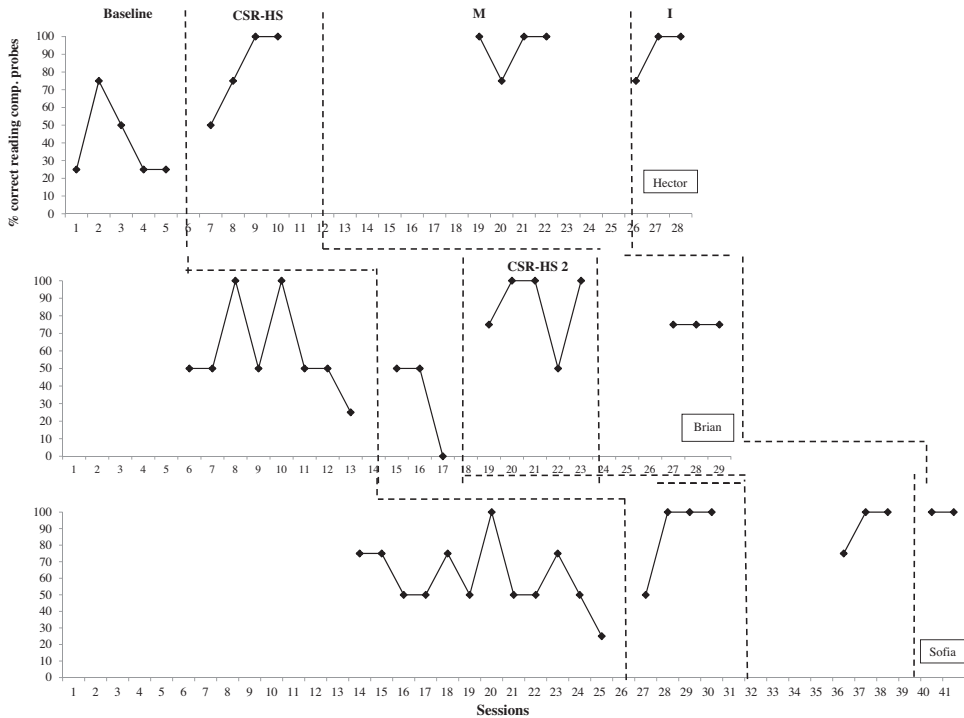


Fig. 3. Occurrences of challenging behaviors.

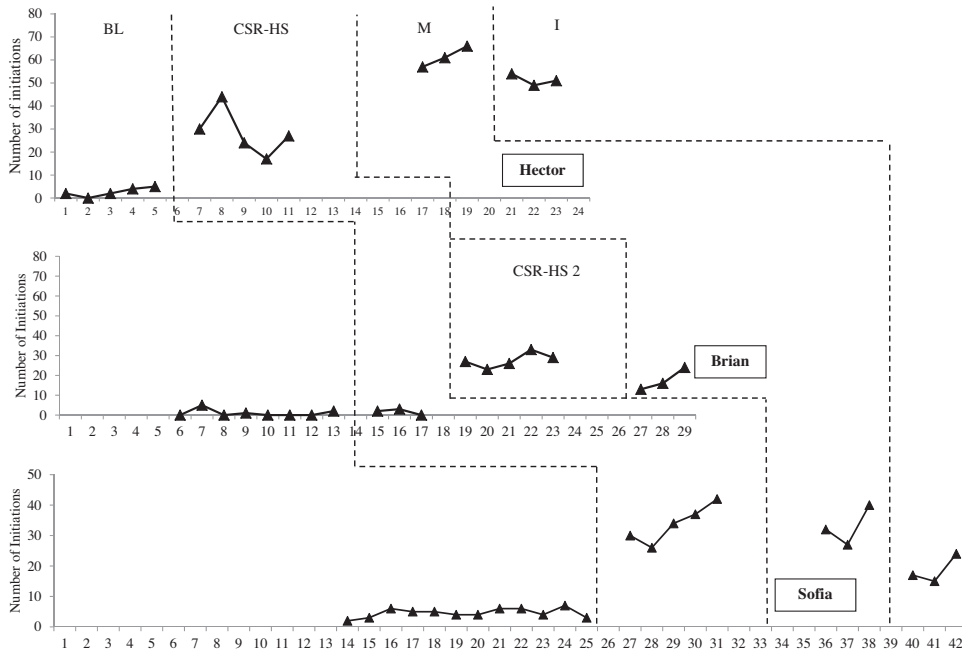


Fig. 4. Frequency of social responding.

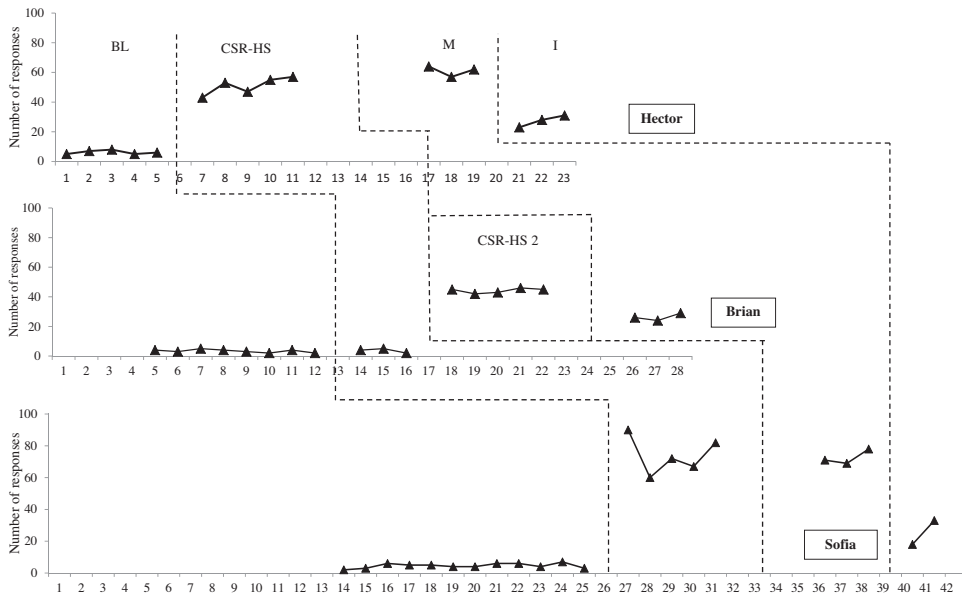


Fig. 5. Frequency of social initiations.

Even though Sofia's level of social initiations decreased during the independent phase (mean of 19), it was still relatively higher compared to baseline.

Similar changes in frequencies were observed for Sofia's social responding dependent variable. Visual analysis of her social responding graph (Fig. 5) reveals an immediate increase in the level of social responding from baseline (mean of 3) to the intervention phase (mean of 74). This increase continued during the maintenance phase (mean of 73) and dropped during the independent phase (mean of 26), which was still higher compared to baseline.

4. Discussion

Overall, across all three participants, accuracy on reading comprehension tasks increased. Although no functional relationship was established, our descriptive data indicate that during treatment, occurrences of social interactions

increased while instances of challenging behaviors decreased. Nonetheless, due to the idiosyncratic nature of ASD, our intervention required the implementer to be aware of and responsive to the individuals targeted. Although Hector and Sofia generally responded positively to the standard protocol as designed, Brian did not. For Brian, working with a peer pair was so overwhelming that the peer was removed. Additional adaptations to the intervention were made, which included replacing written responses with oral ones, the implementer taking on the role of the partner, and putting Brian on a fixed-interval positive-reinforcement schedule where for every 15 min he took part in the treatment, he earned 5 min of game time on the iPad. These changes resulted in Brian receiving an additional phase of intervention (CSR–HS 2).

Although we did not use a formal measure of social validity, through conversations with participating students with and without disabilities, as well as other stakeholders, members of the research team heard confirmation about positive effects of CSR–HS. Students with ASD in our study reported that using the learning strategies gave them more confidence in their abilities to read. While the neurotypical peer partners noted that having shared strategies to work through during a reading assignment helped them feel more at ease in supporting their partner with ASD. The school behavioral specialist acknowledged that he was receiving feedback from content area and special education teachers corroborating that the participating students with ASD were reading more in class, were more willing to work with peers during class assignments, and were volunteering to read aloud in classes.

4.1. Reading comprehension outcomes

Our findings indicate that CSR–HS as designed positively affected reading comprehension outcomes for two of the three participants. Specifically, these two students averaged between 50% and 100% accuracy on comprehension probes during the intervention phase and between 75% and 100% during the maintenance and independent phases. During the initial phase of intervention, Brian's comprehension scores were unexpected and trending in a negative direction (i.e., 50, 50, 0). During the modified second phase of intervention, CSR–HS 2, Brian's mean comprehension score was 85%. He sustained a 75% average during the maintenance phase. As it is well documented that students with ASD struggle with reading comprehension, our findings support Carnahan and Williamson's assertion that for this population of low achieving readers who are expected to read and comprehend grade level texts, "developing strategies that facilitate access to content that is more sophisticated than their reading levels is important to their academic and social success" (2013: 359–360).

4.2. Challenging behavior outcomes

All three of our participants demonstrated a descending trend in their challenging behaviors when engaged in CSR–HS. Brian showed a decrease during both intervention phases (i.e., CSR–HS and CSR–HS 2). The targeted challenging behaviors included off-task behavior, task refusal, and skin picking—all of which researchers had observed and the teaching staff agreed detracted from the target students' ability to focus on academic tasks. Effective delivery of instructions and requests is a key strategy for promoting appropriate behavior (Kern & Clemens, 2007). Because all our participants read below grade level, providing structured strategies and support to tackle an academic task like reading for meaning shows potential for reducing anxiety and allowing for more academic engagement.

4.3. Social interaction outcomes

Social interaction, both initiations and responses, trended upward for all students when involved in intervention sessions and, as we expected, dropped during the independent phase when the pair component was removed. Even though participants spent the majority of their school day in inclusive classes, they had little to no interaction with classmates. Classroom interaction was often limited to a paraprofessional when one was available. Our intervention was designed to promote social interaction around involvement in an academic task. Kamps, Barbetta, Leonard, and Delaquadri (1994) acknowledged that the opportunity to interact is essential for students with ASD.

5. Conclusion

The present study brings reading comprehension research on adolescents with ASD into a secondary school setting, an area for which little is known about what these students experience (Seltzer, Shattuck, Abbeduto, & Greenberg, 2004). Even though effects differ across participants, all three of our students with ASD demonstrated that comprehension outcomes can be positively affected when reading comprehension strategies adapted for individuals with ASD are introduced and their use is supported across the reading process (before, during, and after reading) either with a peer or another instructional support provider. Further, decreasing instances of challenging behaviors and increasing social interactions were noted for the participating students with ASD, who often have limited and awkward interactions with others. We demonstrated, although in a very limited capacity, that it is possible to target academic skills while attending to behavior and social interaction shortfalls, which are often identified as the areas of biggest need for this student population. This is an interesting finding, as research and instruction for students with ASD often focus on behavior and functional skills development at the expense of academics. Our findings suggest that stand-alone behavior interventions may not always be necessary. Instead, it is possible that the challenging behavioral of some secondary students with ASD might be significantly reduced through a

combination of increasing these students' academic engagement and social engagement through use of reading strategies and peer partnerships.

Although we designed a standardized research protocol, student differences necessitated individualized adaptations. We included instructional practices appropriate for students with ASD (e.g., prompts such as visual aids, highly structured and standard procedures, opportunities for self-monitoring and immediate feedback and guidance), but the level of intensity varied by participant. In addition, the peer partner component worked for only two of our participants. Peer-mediated intervention has garnered much attention and has been documented as effective in facilitating the educational inclusion of children with ASD (Harrower & Dunlap, 2001), though working with a peer partner did not work effectively for Brian. These are important considerations for researchers and implementers. As is true for all students with disabilities, a one-size-fits-all approach is not appropriate.

5.1. *Limitations*

This pilot study addressed an understudied topic; however, there are many limitations. First, the small number of participants constrains our findings. Secondly, because of the exploratory nature of our study, we did not demonstrate a functional relationship between our dependent and independent variables, nor did we systematically manipulate the independent variable. Due to time constraints, school officials would not allow functional assessments on participating students with ASD to be conducted by the research team. Third, the delayed-multiple-baseline design is one of the weakest multiple baseline designs and does not allow us to demonstrate whether changes in the targeted students were due to treatment, chance, or treatment effect. Fourth, our reading comprehension measures consist of only four multiple-choice questions. We included publisher-created multiple-choice questions because that type of assessment most closely mimics the daily classroom checks teachers use to quickly assess student progress, but more meaningful assessment measures such as cloze procedures or open-ended questions may prove more reliable sources for measuring comprehension outcomes. Furthermore, each student had very distinct characteristics and deficits in the areas of both academic and social skills that required specific adjustments to our research design, making generalizability of study results impossible. Additionally, we did not independently assess participants' IQ scores and relied on school authorities to select students with ASD meeting our study criteria. While all three students were identified as having IQs between 80 and 100, individual IQ scores were not made available to the researchers. Neither were we allowed to conduct an independent evaluation to confirm autism diagnoses reported or to distinguish between mid to moderate or severe autism.

Because participants received the intervention during an advisory period and the research staff implemented the intervention, our ability to translate the research into practice and to provide instances of how the intervention translates to other content areas and instructional settings is greatly restricted. We realize that such information is sorely needed for practitioners and we hope to better address their needs in future studies. In addition, we included a peer component but collected data on only our target students with ASD. Reciprocity is an important consideration for both partners and deserves attention. Considering that our purpose was to test the efficacy of our intervention on students with ASD, that is where we placed our focus. That is not to say that our peers did not benefit, since peers obtained service hours and expressed enjoyment in working with the targeted students. These students were designated as peer partners because they were exceptional students and had positive interactions with the targeted students. Implementation of this intervention within a classroom setting may require much more careful consideration around pairing decisions to ensure that all parties can benefit from the reading strategies and assigned comprehension activity.

Another limitation involves the use of standardized pretest and posttest reading measures. We administered the passage comprehension subtest of the WJIII but provide scores only as a descriptive measure of students' reading comprehension grade equivalent; school records were dated, and the instructional staff could only estimate the reading levels of targeted students. Standardized measures have not proven to be reliable with this population, and although some growth was noted from pretest to posttest, except for Sofia, the growth was not significant, nor did we expect significant changes in comprehension outcomes considering the short intervention phased under which CSR-HS was piloted. Finally, the cooperating school dictated our late spring implementation schedule. Spring state standardized testing preparation and examination dates and other noninstructional activities such as pep rallies and assemblies impeded sessions and restricted the number of data points that could be collected before the end of the school term.

5.2. *Implications for practice and research*

This study suggests that a reading comprehension intervention targeting adolescents with ASD has the potential to extend benefits beyond improvement in reading for meaning to better address the many challenges associated with ASD. For those for whom it is appropriate, the peer component offers an increased opportunity to interact with classmates without the potential stigma of working with a paraprofessional, thus promoting social acceptance by peers and general education personnel. The self-management feature of the student checklist combined with the learning log allows students with ASD to become actively involved in the reading process and their knowledge acquisition. We further speculate that when the appropriate structure and supports are in place, greater engagement in academic tasks may be achieved.

Even though this intervention is conceivable for classwide use, more research is needed to establish experimental control. Because high-functioning secondary students with ASD often spend the majority of their instructional day in inclusive

settings, it is worthwhile to investigate whether the CSR–HS intervention is effective and efficient for promoting academic achievement and social interactions of both students with ASD and their peers without ASD. Furthermore, in our study, we ensured that reading materials used were at the focus students' instructional reading levels. Participating students read many grade levels below that of their actual grade (mean = 7). For classwide implementation, it is likely that the reading level of material would have to be much higher, and it has yet to be determined whether the strategies included in CSR–HS are sufficient for the demands of reading more difficult text. We suggest that implementing the intervention as we did is a good starting point for students with limited reading and social skills similar to the students who participated in our study. Once students with ASD build a sufficient base in working with peers and applying reading strategies, classwide implementation may have a much better chance of success.

Ethical approval

This study was approved by the Human Subjects and Institutional Review Board for the Office of Research Support at The University of Texas at Austin.

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Conflict of interest

The authors declare no conflict of interest.

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