Article

Behavior Modification
1–24

DOI: 10.1177/0145445517698654
journals.sagepub.com/home/bmo
SAGE

Exploring the Moderating Effects of Cognitive Abilities on Social Competence Intervention Outcomes

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Abstract
Many populations served by special education, including those identified with autism, emotional impairments, or students identified as not ready to learn, experience social competence deficits. The Social Competence Intervention-Adolescents' (SCI-A) methods, content, and materials were designed to be maximally pertinent and applicable to the social competence needs of early adolescents (i.e., age 11-14 years) identified as having scholastic potential but experiencing significant social competence deficits. Given the importance of establishing intervention efficacy, the current paper highlights the results from a four-year cluster randomized trial (CRT) to examine the efficacy of SCI-A (n = 146 students) relative to Business As Usual (n = 123 students) school-based programming. Educational personnel delivered all programming including both intervention and BAU conditions. Student functioning was assessed across multiple time points, including pre-, mid-, and post-intervention. Outcomes of interest included social competence behaviors, which were assessed via both systematic direct observation and teacher behavior rating scales. Data were analyzed using multilevel models,

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with students nested within schools. Results suggested after controlling for baseline behavior and student IQ, BAU and SCI students differed to a statistically significant degree across multiple indicators of social performance. Further consideration of standardized mean difference effect sizes revealed these between-group differences to be representative of medium effects ($d > .50$). Such outcomes pertained to student (a) awareness of social cues and information, and (b) capacity to appropriately interact with teachers and peers. The need for additional power and the investigation of potential moderators and mediators of social competence effectiveness are explored.

Keywords
social competence, cognitive abilities, intervention

Current research points to a clear relationship between the ability to navigate social environments and difficulties in academic functioning (Burt, Obadovic, Long, & Masten, 2008; Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). The nuances of this association can be particularly difficult to pinpoint and to create programming for students considered without intellectual impairment but who nevertheless exhibit significant social challenges. For example, students manifesting higher functioning forms of autism spectrum disorders (ASD) may have difficulty accurately attending, reading, and responding to the emotional cues of others and effectively using conversational skills (de Vries, Prins, Schmand, & Geurts, 2015). Similarly, students classified with emotional/behavioral disorders (EBD) experience challenges in regulating emotions and behaviors at appropriate times and often ascribe negative attributions to others' behavior (Walker & Gresham, 2014). Concurrently, these students with ASD or EBD may have reduced ability to accurately understand and respond to social situations when required to attend to multiple aspects of a situation (Loveland & Tunali-Kotoski, 2005). These sorts of social skill challenges inhibit opportunities for successful academic peer collaborations and in developing positive relationships with teachers, both of which continue a negative feedback loop for these students socially and academically (Sutherland, Lewis-Palmer, Stichter, & Morgan, 2008). These challenges become more apparent in the face of the increasing demands of secondary (e.g., middle school) settings. Despite the scholastic potential of students with high functioning (ASD) or related social skills challenges, these students' social competence deficits may result in greater discrepancies academically (Sansoti & Sansoti, 2012). Thus, targeted interventions to address the interrelated array of social challenges are of paramount importance.

Although there are increased efforts to identify evidence-based practices (EBPs) for students with social competence challenges (e.g., Cook & Cook, 2011), there remains a research-to-practice gap for the use of interventions that meet the criteria for EBPs within schools (Odom et al., 2005). This gap is exacerbated by the lack of research regarding the identification of moderators of treatment response, that is, variables that influence the presence or strength of the relationship between an intervention and various outcomes (Baron & Kenny, 1986). Such research is highly beneficial, as it permits the detection of individuals for whom an intervention could be expected to be effective, as well as a separate group of individuals who are expected to be unresponsive. This lack of moderation research might be partly a result of the current trend toward large scale studies of intervention efficacy that focus on the robustness of main effects of intervention and have less emphasis on exploration of specific factors that may influence differential intervention effects for some students versus others (and thus inhibit overall main effects; Koenig, De Los Reyes, Cicchetti, Scahill, & Klin, 2009). As such, though the field of education and intervention has worked to provide guidelines to assist school personnel in selecting EBPs to address students' particular challenges (Cook & Odom, 2013; National Autism Center, 2009), there is still a need for recommendations regarding which students will benefit most from different services and how interventions should be structured for optimal effectiveness (Cook & Cook, 2011).

An increased body of work has highlighted the importance of targeting intervention based on a continuum of severity in social competence deficits, as opposed to differential diagnosis. The significance of these deficits magnifies with age (Klin et al., 2007), as does the impact on outcomes within and post school. The increasing prevalence of these deficits within the general population highlights the importance of measuring and treating such traits regardless of ability to meet diagnostic significance. Those students with less clearly delineated characteristics are either not identified for social deficits or are overshadowed by concurrent diagnoses, such as those related to behavior or attentional challenges (Skuse et al., 2009). Although social challenges may be common across students, finding appropriate interventions for students who present with similar social problems yet disparate cognitive and behavioral profiles poses a continued challenge for schools.

Role of Cognitive and Verbal Functioning in Social Outcomes and Intervention

There is growing empirical evidence in the field of education and intervention research indicating a correlation between cognitive functioning and social competence for school-aged children (e.g., Skuse et al., 2009). Schools often perform cognitive assessments (e.g., IQ tests) as part of the process of identifying student need and eligibility for special education services. Such assessments typically generate overall indices of cognitive ability (i.e., full-scale IQ [FSIQ]), as well as more defined indicators of verbal (i.e., VIQ) and nonverbal (i.e., NVIQ) abilities. Outside of labeling general categories of functioning (e.g., "normal" IQ range, cognitive impairment), school personnel are not provided direct insight on how these specific cognitive profiles may impact programming decisions or response to intervention. This array of indicators is important given the varying profiles of students with ASD, EBD, and related disorders.

Several studies have highlighted the variations within subgroups of students. For example, among students with ASD, those with significantly lower VIQ than NVIQ scores were found to have more impairment in social functioning (Joseph, Tager-Flusberg, & Lord, 2002). Similarly, subsequent research found that students with ASD and who had a higher VIQ than NVIQ demonstrated fewer problematic social symptoms and better adaptive communications skills (Black, Wallace, Sokoloff, & Kenworthy, 2009). Other research has noted poorer verbal ability/language skills among a large proportion of their sample of students with conduct disorder (Gilmour, Hill, Place, & Skuse, 2004). Similar to EBD, the authors suggested that the behaviors common to these types of students (e.g., hostility, aggression, disruption) may have some underpinnings in verbal and pragmatic language challenges. Other research suggests that VIQ is positively associated with understanding of others' perspectives (Ozonoff, Pennington, & Rogers, 1991). It may be that if students are challenged to find adequate ways to verbalize their wants and needs, or to recognize or label the emotions of themselves or others, the likelihood of misunderstandings or awkward social exchanges is heightened.

Current Study

Given the patterns of association between IQ, specifically verbal abilities, and social communication and interaction, it stands to reason that examining how these abilities may impact response to social intervention is a key question. The Social Competence Intervention–Adolescents (SCI-A; see Stichter, Herzog, Owens, & Malugen, 2016; Stichter et al., 2010, for full descriptions of intervention content and structure) was specifically designed to address both the social skill and performance deficit needs of youth with high functioning ASD or similar social challenges (e.g., EBD) who have scholastic aptitude but are not realizing outcomes consistent with their cognitive potential. SCI-A is based in principals of cognitive behavioral intervention and addresses underlying deficits in social perspective taking (i.e., theory of mind), emotion recognition, and executive functioning (e.g., inhibition control, shifting attention). SCI-A includes five curricular units that address the phenotype-specific challenges characterizing youth with higher functioning forms of autism or related social challenges: (a) recognizing facial expressions, (b) sharing ideas, (c) turn taking in conversations, (d) recognizing feelings and emotions of self and others, and (e) problem solving. These units are delivered in a scaffolded fashion, with each new unit building upon and incorporating the skills learned in the prior units. This instruction process identifies critical social skills and concepts while increasingly providing natural opportunities for practice and independence through activities such as modeling, role-playing, and performance feedback (el Zein, Solis, Vaughn, & McCulley, 2014).

Previous research on SCI-A indicated positive gains in student performance of underlying pivotal skills and in parents' and teachers' assessments of student social functioning (Stichter et al., 2016; Stichter et al., 2010). Previous research also has demonstrated the feasibility and acceptability of SCI-A for delivery to this group of students within school settings (Stichter et al., 2016). Given the importance of establishing intervention efficacy in real-world settings for these youth, the current article examines data from a 4-year cluster randomized trial (CRT) to examine the efficacy of SCI-A relative to "business as usual" (BAU) school-based programming for a broader range of students identified with similar social and cognitive ability. A single research questioned was posed: To what extent does student IQ moderate the effect of SCI-A on student social behavior in the school setting? We hypothesized that the various IQ indicators would moderate the relationship between intervention and outcomes, such that the differences between SCI-A and BAU on teachers' reports of student social functioning would vary in accordance with IQ level.

Method

Participants and Settings

Across 4 years of the CRT, 34 publicly funded middle schools in one Midwest state agreed to participate. Participating districts/schools nominated and consented students meeting designated inclusion criteria: absence of intellectual disabilities (based on FSIQ), access to general education curricula/peers, absence of significant mental health diagnoses, and school-identified social needs consistent with characteristics and challenges often associated with HFA (Solomon, Goodlin-Jones, & Anders, 2004). SCI-A's inclusion criteria are consistent with other similar social interventions for this population and hence are necessary given the cognitive-behavioral underpinnings of the intervention. Each school had to have a minimum of four students who met eligibility criteria to remain in the study. Using a CRT design (Hedges & Rhoads, 2010), within each year, participating schools were randomly assigned to either the SCI-A condition (j = 28) or the BAU condition (j = 26). Building-level randomization not only met the sampling needs for our target student characteristics but also reduced threats to internal validity as a result of treatment contamination or diffusion within buildings (Donner & Klar, 2000; Shadish, Cook, & Campbell, 2002). Although some buildings participated in multiple years or had more than one group of students, each group/cohort of students was unique with no prior exposure to SCI-A. At the conclusion of each year, SCI-A curriculum materials were removed from the building (returned if SCI-A was implemented the following year or at the conclusion of the study). Only three buildings were in the SCI-A condition first, then the BAU condition a subsequent year; based on our monitoring of students' social programming and consistent with school contracts for BAU participation, SCI-A features were not utilized during the subsequent BAU assignment.

Students. Parent consent was obtained for 292 students (n = 155, SCI-A; n = 137, BAU). After consent, 11 students were determined to be ineligible based on misreported IQ (i.e., below inclusion threshold) or behavioral characteristics (e.g., aggression, inability to maintain in general education), four students moved from the participating school, and schools dropped three students due to schedule or programming changes. Thus, 274 students were assessed at Time 1 (T1: n = 146, SCI-A; n = 128, BAU). After attrition due to student programming changes, students' moving from the participating school, and one school leaving the study, 253 students were assessed at Time 2 (T2: n = 135, SCI-A; n = 118, BAU). T1 was completed in December or January prior to onset of intervention in early to mid January, respectively. T2 was scheduled approximately 2 weeks after the conclusion of SCI-A and typically occurred in late April/early May (depending on implementation schedules; M = 139 days from T1 to T2). Given our modern missing data handling techniques (i.e., full information maximum likelihood [FIML]), all students assessed at T1 are included in all analyses below, regardless of their completion of T2. Inclusion of participants who did not complete T2 can improve power to detect effects, but it assumes that missing data are missing due to a missing completely at random (MCAR) or missing at random (MAR) mechanism (Schafer & Graham, 2002). Investigation of the reasons for participant nonresponse at T2 indicated that the assumption of MCAR or MAR missing was reasonable.

Table 1 includes demographic characteristics of all students assessed at T1. Consistent with ASD and EBD prevalence rates, most participating students were male (84.7%). Students ranged from 11.4 to 15.4 years old and had adequate cognitive functioning. The majority of students were eligible for special education services, with most qualifying under the categories of autism, emotional disturbance, or other health impairment. We conducted tests for group differences in characteristics salient to or included in the present research question. Students in the BAU condition had significantly higher FSIQ, $t(271) = 2.15$, $p < .05$, and NVIQ, $t(271) = 2.27$, $p < .05$, than students in SCI-A; there was no significant difference in VIQ across condition. Students in the SCI-A condition compared with their BAU peers had elevated scores on the School Social Behavior Scales (SSBS) Antisocial Behavior scale, $F(1, 269) = 29.99$, $p < .001$. There were also significant condition differences in diagnostic reports of ASD and/or other behavioral diagnoses, $\chi^2(3) = 14.94$, $p = .002$, and special education eligibility categories, $\chi^2(7) = 14.96$, $p = .037$.

Social programming. Within the SCI-A condition, participating buildings agreed to make the SCI-A curriculum students' primary setting for social instruction during the spring semester. SCI-A is founded on principles of applied behavior analysis, cognitive behavior intervention, and evidence-based teaching practices (e.g., specific verbal feedback, the prompting hierarchy, behavior management, and cognitive mapping). SCI-A was delivered by one specifically trained implementer in a group format (4-6 students; $M = 5.21$ students per group). SCI-A was delivered in 32 lessons at designated, consistent times (e.g., 45-min lessons, always during the same period on specific days) during the spring semester. As noted in Stichter et al. (2010) and Stichter et al. (2016), SCI-A involves a clear scaffolding of both learning specific socially related skills and content and a scaffolding of instructional and practice opportunities. Participating schools referred personnel to be trained to implement SCI-A. These personnel were generally those who would typically work with students in the target population in social and/or academic settings. Trained implementers were either special educators ($n = 22$) or speech language pathologists ($n = 6$). Of these, four implementers provided SCI-A to more than one group of students across years.

As all students consented for the study were identified as needing and receiving social programming, buildings in the BAU condition were asked to designate each student's existing, or "business as usual," social programming prior to the start of the study. The designated BAU programming varied in number of students present (individual, group), educational setting (special education, speech services, general education), delivery frequency (daily,

Table 1. Student Baseline Demographic Characteristics.

	SCI-A (28 schools)		BAU (26 schools)	
	n	%	*n*	%
Students consented	155		137	
Students tested at Time 1	146	94.2	128	93.4
Sex (males)	124	84.9	108	84.4
Race/ethnicity[a]	110		92	
White	90	81.8	81	88.0
Black	4	3.6	3	3.3
Hispanic	4	3.6	2	2.2
Other or multiple	12	10.9	6	6.5
Special education eligibility				
Autism	69	47.3	82	64.1
Emotional disturbance	39	26.7	15	11.7
Other health impairment	23	15.8	12	9.4
Specific learning disability	2	1.4	2	1.6
Speech or orthopedic impairment	4	2.7	6	4.7
No eligibility	4	2.7	4	3.1
No Individualized EducationPlan, had Section 504 Plan	5	3.4	7	5.5
Diagnosis by outside professional[b]				
No ASD or behavioral	36	24.7	48	37.5
Any ASD, no behavioral	21	24.4	27	21.1
Any ASD + any behavioral	32	21.9	29	22.7
Any behavioral, no ASD	57	39.0	24	18.8
	M	*SD*	*M*	*SD*
Age in years (*M, SD*)	12.88	0.88	12.98	0.98
Full IQ score (*M, SD*)[c]	98.36	14.38	102.00	13.45
Verbal IQ score	98.11	14.72	101.00	14.57
Performance IQ score	98.38	14.80	102.46	14.81
School disciplinary records[d]				
Number of “minor” referrals	1.17	2.83	0.55	1.32
Number of “major” referrals	0.36	0.82	1.11	0.10

Note. SCI-A = Social Competence Intervention–Adolescents; BAU = business as usual; ASD = autism spectrum disorders; ADHD = attention-deficit/hyperactivity disorder; WISC-IV = Wechsler Intelligence Scale for Children–Fourth edition; WASI = Wechsler Abbreviated Scale of Intelligence.
[a]Race/ethnicity reported by parents via a mailed demographic survey. Reported data are based on returned surveys only.
[b]Any mental health diagnosis provided by an external medical or psychological professional as noted in school records (this excludes a school-based “diagnosis” or classification for special education services); “Behavioral” includes any internalizing or externalizing behavioral diagnosis (e.g., anxiety, ADHD, oppositional defiant disorder).
[c]Full IQ scores obtained via either WASI Full Scale IQ or WISC-IV Global Ability Index, Verbal and Performance scores as indicated on either test.
[d]Neither schools nor project specified a definition of “minor” and “major” discipline referrals.

weekly), delivery method, and content covered. For example, some students were identified as receiving weekly group-based social skills instruction, whereas others received individualized social feedback from paraprofessionals daily within a general education classroom. The current study was funded to compare SCI-A with BAU/existing social practice; thus, by design, the research team could not control any existing elements of BAU. Identified BAU implementers specifically were asked not to change their typical programming or interactions with the target student(s) in any manner during the spring semester to provide this accurate comparison between SCI-A and existing practice.

Across both the SCI-A and BAU conditions, we assessed the extent to which instruction was implemented with fidelity to core components (FCC) of effective social intervention (Owens, Stichter, & Herzog, 2014). The FCC was not designed as a measure of specific adherence to SCI-A curriculum, but it does provide a proxy measure of treatment integrity across social competence instruction. The FCC is comprised of two primary facets: social content and effective instructional/procedural practices (i.e., process). The content fidelity evaluated essential concepts of social competence programming needed for intended student outcomes. Content codes were theoretically derived from relevant, empirically supported social competence interventions for the target population, including SCI-A, as well as expert opinion within the social competence field. Seven content fidelity codes and one "other" code emerged: (a) facial expressions, (b) speaker behaviors, (c) listener behaviors, (d) turn taking/reciprocity, (e) emotional range and regulation, (f) problem identification, (g) problem solutions, and (h) other (e.g., social ideas like friendship or manners). The process fidelity measured how teachers deliver social competence programming including the use of evidence-based instructional techniques and specific instruction methods. Process codes were drawn from literature regarding the effectiveness of scaffolded instruction, applied behavior analysis, cognitive behavior intervention, and other EBPs. Five codes related to instructional techniques were created: (a) provision of specific verbal feedback, (b) self-monitoring opportunities, (c) perspective taking opportunities, (d) use of cognitive strategies, and (e) effective prompting/clarification. In addition, the FCC measured five types of instructional methods: (a) introduction/didactic instruction, (b) modeling demonstrations, (c) opportunities for guided and naturalistic practice, (d) review of information, and (e) engaging in undefined/unstructured or nonsocial instruction (e.g., downtime, academic work). Trained observers used partial interval coding methods and gathered a minimum of ten 15-min observations (30 intervals of 30 s each) for all SCI-A and BAU settings during the spring semester. Data were translated into a proportion of intervals in which each core instructional component (e.g., content, process) was observed. Observers were trained to reach a minimum of 85% interrater reliability on practice videos; during active data collection, 36.6% of observations were double coded and interobserver agreement ranged from 93.3% to 99.3% across all codes. Observers were not blind to intervention condition given that SCI-A was always delivered to a group of students, whereas students in BAU rarely were in a group-based social instruction. As such, by design, the context of the data collection removed any anonymity to condition.

Examinations of FCC differences across condition suggested significant differences in all instructional components. To examine this we created a proportion score for every FCC observation, the following represent the average for all SCI and for all BAU respectively. For example, SCI-A implementers more frequently delivered specific concepts, such as good speaker skills (SCI-A: $M = 0.309$, BAU: $M = 0.046$), $t(1{,}036) = 16.17$, $p < .001$, or understanding emotional range and perspectives (SCI-A: $M = 0.279$, BAU: $M = 0.040$), $t(1{,}036) = 15.05$, $p < .001$, whereas teachers in BAU settings more frequently discussed social concepts like manners or friendship (SCI-A: $M = 0.057$, BAU: $M = 0.102$), $t(1{,}036) = 3.12$, $p = .002$. SCI-A teachers utilized more specific verbal feedback about students' social knowledge and performance (SCI-A: $M = 0.096$, BAU: $M = 0.008$), $t(1{,}036) = 19.88$, $p < .001$. SCI-A teachers also provided more frequent opportunities for students to observe social models (SCI-A: $M = 0.117$, BAU: $M = 0.074$), $t(1{,}036) = 10.80$, $p < .001$, and to practice social skills/interactions with group mates (SCI-A = 0.351, BAU = 0.066), $t(1{,}036) = 16.64$, $p < .001$. In contrast, BAU teachers were more frequently engaged in nonsocial/undefined instructional time (SCI-A = 0.070, BAU = 0.797), $t(1{,}036) = 34.94$, $p < .001$.

Measures

Student IQ. IQ was assessed using either the Wechsler Intelligence Scale for Children–Fourth edition (WISC-IV; Wechsler, 2003) or the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). If schools reported recent results from one of these tests in school records, that score was used. If students had IQ scores via another assessment or had no IQ score on file, trained master's-level project staff assessed IQ using the WASI. To create comparable assessment values, the FSIQ score used in this analysis is either the WISC-IV General Ability Index (GAI) or the WASI full-scale score. The VIQ and NVIQ scores for each test are also reported. All IQ scores are presented based on norm-referenced standardized scores ($M = 100$, $SD = 15$). IQ discrepancies were calculated as VIQ minus NVIQ, with positive scores representing higher verbal than nonverbal abilities (i.e., VIQ > NVIQ).

Student diagnosis. Upon referral to the project, schools reported what diagnosis, if any, the student had on file. Diagnoses are reported here if they were provided by an external medical or psychological professional (i.e., school-based special education eligibility categorization did not count as a diagnosis). For use as a covariate in the analyses, students were classified into one of four categories (see Table 1) related to the presence/combination of any ASD and/or any behavioral diagnosis (e.g., attention-deficit/hyperactivity disorder [ADHD], oppositional defiant disorder, anxiety, etc.).

Antisocial behavior. The SSBS (Merrell, 1993) assesses both socially competent and antisocial behaviors. Each participating student was assessed via the SSBS by one school/district professional who knew the student well. To complete SSBS Antisocial Behavior items, professionals rated how often students exhibited behaviors characterized as hostile, aggressive, or disruptive on a 5-point Likert-type scale, with higher scores indicating greater social behavior problems. Reliability of the Antisocial Behavior scale in this sample was good (Cronbach's $\alpha = .92$). SSBS data were collected prior to T1 to aide in generating a preintervention behavioral profile for each student. In the current analyses, the Antisocial Behavior scale served as a covariate, permitting the ability to control for baseline levels of student behavior.

Social responsiveness. One general education teacher per student completed the Social Responsiveness Scale–Second edition (SRS-2; Constantino & Gruber, 2012). SRS-2 was completed at T1 and T2 to assess social and behavioral characteristics across five domains in which individuals on the autism spectrum typically struggle: social cognition, communication, awareness, and motivation; restricted interests/repetitive behaviors. The SRS-2 was designed to assist in treatment decisions, measure behavior change subtleties over time, and assess response to intervention. Research has shown SRS-2 scores can be used across populations to distinguish ASD symptoms from other disorders impacting social behavior. Behaviors are rated on a 0 to 3 Likert-type scale, and consistent with clinical diagnostic assessments, higher scores represent more problematic social challenges. Reliability of SRS-2 Awareness subscale was low at T1 and T2 (Cronbach's $\alpha = .50$ and .64, respectively), but all other subscales were acceptable at both timepoints (Cronbach's $\alpha = .78$-.90). Teachers completing the SRS-2 were aware that the student was part of a study, but were blind to the study's aims and curricular content.

Data Analytic Plan

The primary research question regarding the moderating effect of student IQ on SCI-A effectiveness was evaluated via multilevel modeling (MLM). MLM recognizes the nested structure of the current data (i.e., students nested within schools) and is commensurate with the CRT design, through which schools (not students) were randomly assigned to intervention condition (i.e., SCI or BAU). The main effect of SCI-A was evaluated via a dichotomous grouping variable, coded as 0 = BAU and 1 = SCI-A. The social outcomes of interest were SRS-2 subscale scores at T2. A series of covariates were entered into each model: T1 SRS-2 score, student diagnostic category, antisocial behavior score, FSIQ score, and the effect of the grouping variable (a Level 2 variable). Student diagnosis, antisocial behavior, and FSIQ were included as covariates given the significant group-level differences reported earlier; within the resulting findings, the reported mean difference between conditions in SRS-2 scores control for these covariates. Effect sizes represent a standardized mean difference between groups at T2, with standardization using the total variance in the outcome variable.

Moderation by FSIQ, VIQ, or VIQ–NVIQ split was assessed by fitting a multilevel model with the same predictors as the main effect models, but with different measures of IQ depending on the moderator of interest. All models investigating moderation by VIQ–NVIQ split included FSIQ as a covariate, whereas models investigating moderation by FSIQ or VIQ only included the measure of IQ of interest in the model. To assess moderation, the product of the moderator and the condition variable was computed and included as a Level 2 predictor in the model. The slope of the product term provides a test of the moderation of intervention condition by IQ. Simple slopes, representing the effect of SCI-A at lower and higher levels of IQ, were used to probe interactions. Simple slopes were computed for clinically meaningful levels of IQ. For FSIQ and VIQ, these values were set at 1 standard deviation above (115 = high average) and below (85 = low average) the normative standard score mean (Wechsler, 2003). For VIQ–NVIQ split, values of −11 (lower VIQ) and +11 (higher VIQ) were used, representing bounds for statistically significant ($p < .05$) difference magnitudes per Wechsler IQ tests (Black et al., 2009). Effect sizes were computed for all simple slopes. Effect sizes represented the standardized mean difference between groups at the specified value of the moderator, with standardization using the total variance in the outcome variable.

All tests of statistical significance were compared relative to a critical p value of .05. Effect sizes were evaluated in terms of magnitude, with .20 representing a small effect, .50 a medium effect, and .80 a large effect (Cohen,

Table 2. Main Effect of Treatment Group (SCI-A vs. BAU) on Postintervention Social Outcomes.

SRS-2 subscale	Mean difference	*SE*	*p*	*d*
Awareness	−0.01	0.08	.853	−0.03
Cognition	0.15	0.06	.013	0.31
Communication	0.01	0.06	.838	0.03
Motivation	0.11	0.09	.227	0.22
Restricted/Repetitive Behavior	0.02	0.08	.855	0.03

Note. Negative mean difference and effect size values indicate SCI-A students exhibited lower SRS-2 scores relative to BAU students (i.e., more positive behavior in the SCI-A group): 0.20 = small effect size, 0.50 = medium effect size, 0.80 = large effect size. SCI-A = Social Competence Intervention–Adolescents; BAU = business as usual; SRS-2 = Social Responsiveness Scale–Second edition.

1988). Missing data were handled using full FIML for all analyses. FIML uses all available data for each individual when computing maximum likelihood estimates of parameters (Schafer & Graham, 2002). Results from FIML are equivalent to results using multiple imputation to handle missing data, assuming a large number of imputations. All analyses were conducted using Mplus v. 7.12 (Muthén & Muthén, 2014).

Results

As an important first step, we examined main effects of intervention condition on social outcomes without moderating IQ factors (see Table 2). Of interpretive note, given the directional coding of the SRS-2, negative mean difference and effect size values indicate lower SRS-2 scores (i.e., more positive social functioning) for SCI-A relative to BAU. There was a general pattern across subscales, whereby T2 SRS-2 scores were not significantly different between conditions, indicating no clear efficacy differences for SCI-A versus BAU.

Examining Differential Response by IQ

FSIQ. See Table 3 for a summary of findings regarding the moderation by FSIQ on intervention condition. The interaction between FSIQ and intervention condition was significant for the Communication subscale; all other subscales demonstrated the same intervention effect pattern across values of FSIQ. Examination of effect sizes of the simple slopes reveals distinct patterns for those groups characterized by lower (85) versus higher (115) FSIQ.

Table 3. Moderating Effect of FSIQ on SCI-A Versus BAU Postintervention Social Outcomes.

				Mean difference			
SRS-2 subscale	Interaction slope	*SE*	*p*	Low FSIQ[a]	High FSIQ[a]	d_{Low}	d_{High}
Awareness	0.01	0.01	.157	−0.16	0.16	−0.40	0.40
Cognition	0.02	0.01	.170	−0.07	0.37	−0.16	0.93
Communication	0.01	0.01	.037	−0.18	**0.22**	−0.46	0.54
Motivation	0.01	0.01	.194	−0.11	0.33	−0.27	0.82
Restricted/ Repetitive Behavior	0.01	0.01	.073	−0.15	0.19	−0.38	0.47

Note. Negative mean difference and effect size values indicate SCI-A students exhibited lower SRS-2 scores relative to BAU students (i.e., more positive behavior in the SCI-A group). Bolded simple slopes are significant $p < .05$; 0.20 = small effect size, 0.50 = medium effect size, 0.80 = large effect size. FSIQ = full-scale IQ; SCI-A = Social Competence Intervention–Adolescents; BAU = business as usual; SRS-2 = Social Responsiveness Scale–Second edition.
[a]Low FSIQ = 85, High FSIQ = 115.

For groups characterized by lower FSIQ, students in SCI-A had lower T2 SRS-2 scores relative to BAU students, indicating more positive social behavior within the SCI-A group, on social awareness ($d = -0.40$), communication ($d = -0.46$), and motivation ($d = -0.27$). In contrast, for groups characterized by higher FSIQ, students in SCI-A had higher scores relative to BAU students, suggesting that SCI-A was less effective across the various social outcome indicators for these higher IQ students.

VIQ. Given the clear role of verbal ability on social behaviors and interactions, we next examined the moderating effects of VIQ on intervention condition (see Table 4). The interaction between VIQ and intervention condition was significant for the Social Cognition, Communication, Motivation, and Restricted/Repetitive Behavior subscales, suggesting the presence of a moderating effect. Examination of effect sizes of simple slopes indicated that for groups characterized by lower VIQ, SCI-A students had lower SRS-2 scores relative to BAU students, indicating SCI-A had positive impact on social communication ($d = -0.50$) for this group. For groups characterized by higher VIQ, SCI-A students had higher SRS-2 scores relative to BAU students, suggesting that SCI-A was less impactful for these students on social cognition ($d = 1.02$), communication ($d = 0.67$), and motivation ($d = 1.02$).

Table 4. Moderating Effect of VIQ on SCI-A Versus BAU Postintervention Social Outcomes.

SRS-2 subscale	Interaction slope	*SE*	*p*	Mean difference Low VIQ[a]	Mean difference High VIQ[a]	d_{Low}	d_{High}
Awareness	0.01	0.01	.123	−0.15	0.19	−0.38	0.47
Cognition	0.02	0.01	.015	−0.11	**0.41**	−0.28	1.02
Communication	0.02	0.01	.004	**−0.20**	**0.27**	−0.50	0.67
Motivation	0.02	0.01	.050	−0.14	**0.41**	−0.35	1.02
Restricted/ Repetitive Behavior	0.19	0.09	.045	**−0.19**	0.19	−0.47	0.48

Note. Negative mean difference and effect size values indicate SCI-A students exhibited lower SRS-2 scores relative to BAU students (i.e., more positive behavior in the SCI-A group). Bolded simple slopes are significant $p < .05$; 0.20 = small effect size, 0.50 = medium effect size, 0.80 = large effect size. VIQ = verbal IQ; SCI-A = Social Competence Intervention–Adolescents; BAU = business as usual; SRS-2 = Social Responsiveness Scale–Second edition.
[a]Low FSIQ = 85, High FSIQ = 115.

VIQ–NVIQ split. See Table 5 for a summary of findings regarding the moderating effects of discrepancies in students' verbal and nonverbal abilities (i.e., VIQ–NVIQ split) on intervention condition. The interaction between VIQ–NVIQ split and intervention condition was significant for the Social Cognition, Communication, and Motivation subscales, suggesting the presence of a moderating effect. Examination of effect sizes of simple slopes indicated that for groups characterized by a lower verbal than nonverbal abilities (i.e., VIQ at least 11 points lower than NVIQ), SCI-A students had lower SRS-2 scores relative to BAU students, suggesting SCI-A had a positive effect on these students' social communication ($d = -0.97$) and motivation ($d = -1.34$) to be social. In contrast, for groups characterized by a higher verbal than nonverbal abilities (i.e., VIQ at least 11 points higher than NVIQ), SCI-A students had higher SRS-2 scores relative to BAU students, suggesting SCI-A was less effective on the social cognition ($d = 1.23$), communication ($d = 1.10$), and motivation ($d = 1.95$) for these students.

Discussion

For the current study, we investigated the role of IQ as a moderator of social intervention response. Trained school personnel delivered the SCI-A as part of a CRT study regarding the efficacy of SCI-A as compared with BAU programming for a sample of 274 adolescents identified with a primary social

Table 5. Moderating Effect of VIQ–NVIQ Split on SCI-A Versus BAU Postintervention Social Outcomes.

				Mean difference			
SRS-2 subscale	Interaction slope	*SE*	*p*	Lower VIQ[a]	Higher VIQ[a]	d_{Lower}	d_{Higher}
Awareness	0.03	0.04	.410	−0.39	0.35	−0.97	0.88
Cognition	0.03	0.01	.004	−0.21	**0.49**	−0.53	1.23
Communication	0.03	0.02	.036	**−0.39**	**0.44**	−0.97	1.10
Motivation	0.06	0.03	.043	**−0.54**	**0.78**	−1.34	1.95
Restricted/ Repetitive Behavior	0.02	0.02	.193	−0.21	0.25	−0.51	0.62

Note. Negative mean difference and effect size values indicate SCI-A students exhibited lower SRS-2 scores relative to BAU students (i.e., more positive behavior in the SCI-A group). Bolded simple slopes are significant $p < .05$; 0.20 = small effect size, 0.50 = medium effect size, 0.80 = large effect size. VIQ = verbal IQ; NVIQ = nonverbal IQ; SCI-A = Social Competence Intervention–Adolescents; BAU = business as usual; SRS-2 = Social Responsiveness Scale–Second edition.
[a]Lower VIQ split = −11, higher VIQ split = +11.

competence deficit. Although all students in the sample were referred by the schools as having no intellectual impairments and considered to manifest primary social challenges (as opposed to extreme behavior challenges), the sample presented with notable ranges in IQ and diagnosis. As such, we did not anticipate strong distinctions within the main effect of treatment between SCI-A and BAU with respect to social outcome scores. Our hypotheses on the role of IQ on social outcomes led to further investigations, which revealed patterns of differential treatment response. More specifically, across several SRS-2 subscales, groups characterized by either lower FSIQ (1 *SD* below the mean), lower VIQ (1 *SD* below the mean), or VIQ < NVIQ split (by 11 points or more) demonstrated greater response to SCI-A (relative to BAU) than their counterparts with higher IQ scores.

Previous research has implicated the role of IQ in the social communication and interactions of students with ASD. In general, these studies suggested that stronger verbal abilities are linked with better adaptive and communicative functioning (Black et al., 2009). VIQ has also been implicated in the social interaction styles of children with ASD (Scheeren, Koot, & Begeer, 2012), suggesting the intertwined nature of verbal abilities and outward social and behavioral profiles. Moreover, when examining verbal abilities relative to nonverbal abilities, research also consistently finds discrepantly low VIQ (and thus discrepantly high NVIQ) is associated with more problematic social impacts (Black et al., 2009; Joseph et al., 2002). Although the links between VIQ and social outcomes are relatively clear, what remains less clear is how VIQ impacts response to social intervention. Although intervention studies often control for students' FSIQ or VIQ, rarely do they examine *how* varying cognitive and verbal abilities modify the impact of intervention effects.

For groups characterized by lower VIQ, students in SCI-A had significantly better social cognition, communication, and motivation compared with BAU students (though effect sizes were small to moderate across all social outcome domains). With respect to students with discrepant verbal and nonverbal abilities, similar patterns were noted with even larger effect sizes. Students with lower VIQ than NVIQ demonstrated positive impacts of SCI-A on social communication and motivation compared with their BAU counterparts. Taken together, these results point to the critical role that VIQ, particularly in relation to NVIQ, plays in how students respond to varying social intervention.

A number of potential mechanisms for the positive impact of SCI-A for groups characterized by lower average IQ are possible. As scholars have suggested, important work in the domain of intervention research is to understand what treatments are effective in addressing students' particular profiles and challenges (Cook & Odom, 2013) and how interventions should be structured for optimal effectiveness (Cook & Cook, 2011). A key feature of SCI-A is the degree of direct instruction that is scaffolded throughout the curriculum and is incorporated into increasingly more complex constructs. Our fidelity data confirmed much higher rates of this type of instruction for SCI-A as opposed with BAU programs. It is logical to hypothesize that youth with lower cognitive abilities benefit more directly from the essential elements of cognitive-behavioral intervention and applied behavior analysis principles in combination with effective teaching practices (e.g., scaffolding of content and instructional method, repetition of content). SCI-A uses these principles via consistent language to describe and enact social concepts (e.g., facial expression recognition, emotion labels, conversational skills, etc.) and uses repetition and scaffolding to provide an opportunity for students to effectively receive and retain these concepts as the program progresses. For example, SCI-A demonstrated small to moderate effects on social communication, the motivation to be social, and social cognition patterns of students with lower verbal abilities. Although SCI-A requires minimum cognitive and verbal capacities, the consistent language and cognitive maps regarding social interpretation and social interaction as well as repeated, scaffolded, and structured opportunities to practice these skills may better address the challenges of students who have lower cognitive and verbal abilities (i.e., 1 *SD* below the norm) than their higher ability peers.

Limitations and Future Directions

As with any study, there are limitations that warrant discussion and that generate additional avenues for investigation. For this study in particular, these limitations are ones that are somewhat common to the complex field of social competence measurement, heterogeneity of student profiles, and challenges of applied intervention research. The SRS-2 was specifically designed to quantify social impairments among those with ASD and has been indicated for sensitivity to change within the manuals. However, questions remain regarding the optimal time period to best capture response to intervention. For example, we used SRS-2 scores gathered approximately 2 weeks postintervention as the outcomes of interest. However, the effects of the intervention might be somewhat delayed, such that they are not fully captured in measurements taken immediately following intervention completion. For behavioral interventions, particularly skills-based interventions, change on outcomes may not be apparent at postintervention but may appear at later dates (e.g., Forster, Sundell, Morris, Karlberg, & Melin, 2010). Examining treatment effects and the moderating effect of IQ on follow-up, via the collection of data weeks or months following intervention completion, may provide additional insights for whom the intervention remains effective. Access to optimal measures that can capture response to intervention across diagnostic groups remain elusive and an important area for the field to continue to focus (Lecavalier, 2016).

It was outside the scope of the current study, but future investigations of the data in this CRT should include more specific examinations of core components of SCI-A that may be related to the differential treatment responses noted above. For example, future analyses should include quantifications of the degree to which SCI-A and BAU implementers provided students with particular social content/concepts and utilized particular instructional strategies and methods. It may be that some specific core components are more strongly associated with the differential response for lower versus higher IQ groups. Such findings could point to important intervention adaptations that may be needed to better match students' needs and optimize treatment response (Cook & Cook, 2011; Cook & Odom, 2013).

As often noted in field-based educational and social intervention research, evaluations of applied practice, even within otherwise well-designed CRT studies, can pose significant challenges, including threats to internal validity (Lecavalier, 2016). Despite the embrace of schools to adopt and deliver a manualized curriculum such as SCI-A, identification of appropriate students for this type of group-based intervention was a challenge for some schools. Diagnostic information within school records tended to be incomplete or highly inconsistent. In addition, SCI-A's purposeful group-based intervention design required students to consistently attend the group together. Although schools identified numerous students who fit the study's inclusion criteria, they were often challenged to be able to modify students' schedules to accommodate the full intervention program. As a result, some students who would have been good candidates were left out and other students who were either highly or minimally impacted were included instead. Students in the SCI-A condition, on average, showed patterns of more challenging behavior concerns, which may have truncated our ability to detect positive effects of SCI-A on students' social behavior. Future investigations should more clearly examine how these behavioral characteristics may moderate treatment response. Also, as a result of the comparison design using a group-based intervention, observers were not blind to intervention condition given that SCI-A was always delivered to a group of students, whereas students in BAU rarely were in a group-based social instruction. Although a common limitation of applied research, future studies ideally would have resources to acquire two unique sets of data collectors blindly assigned to a single condition.

Finally, certain challenges are inherent to the CRT design. CRT-based randomization occurs at the cluster level; thus, it is necessary to draw conclusions regarding statistical findings at the cluster level (Donner & Klar, 2000). Within the current study, this resulted in the requirement to discuss how group levels of cognitive and verbal abilities moderated social intervention response, rather than individual student ability level. While somewhat conceptually challenging, such an interpretation might be considered appropriate in the context of group-based interventions like SCI-A. It is reasonable to assume that SCI-A performance might differ in accordance with group composition given the incorporation of instructional components that impact the broader group, such as discussion, role-playing, and performance feedback. Nevertheless, the reader is encouraged to be mindful when interpreting the current findings, as they differ from those resulting from randomized control trial (RCT) studies founded upon individual student-level randomization.

Implications and Conclusion

The current study contributes to understanding of the role of cognitive and verbal abilities on the social behaviors and interactions of youth with social competence challenges. Specifically, our study demonstrated that FSIQ, VIQ, and the discrepancy between VIQ and NVIQ are key moderators of the impact of social competence intervention on a variety of social outcome domains. Prior research had indicated that lower VIQ was associated with more significant social impacts (Black et al., 2009; Joseph et al., 2002). Accordingly, it appears as though SCI-A is particularly appropriate for those students with cognitive abilities in the lower average range. This documented differential benefit may be related to the nature of the SCI-A intervention and its core components, which is intended to provide students with repeated, scaffolded, and structured opportunities to learn and practice key social skills with which students in this profile typically struggle. Such an intensive and intentional approach to intervention may allow students with lower cognitive abilities to more effectively encounter and acquire the instructed skills. Often schools are challenged to find appropriate interventions for these students and may default to individually based services or services with far less structure (Cook & Odom, 2013). Our study suggests that a group-based intervention like SCI-A may be a more effective choice. Additional inquiry relative to group-based programming for students with higher abilities remains warranted.

To arrive at such intervention decisions, it is necessary that educators have access to quality information to not only assess students' cognitive and behavioral profiles but also understand how these profiles are associated with intervention response. Providing schools with more standardized means by which to match students' profiles to intervention (i.e., reliable screening tools whose scores predict treatment response) remains a key issue that intervention researchers should continue to address. In addition, the results of this study suggest that issues of the constellation of group characteristics may be important factors to consider. Although SCI-A was not consistently effective across the range of IQ, that it was effective in the lower average IQ range in particular suggests that these types of students may benefit most from group-based interventions with peers who have similar challenges. Thus, if educators can appropriately measure student characteristics, they can better match students to intervention, realizing increased response to intervention.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was supported by grant

R324A120027 from the U.S. Department of Education, Institute for Education Sciences, Special Education Research Program (Janine Stichter, Principal Investigator).

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