Psychosocial and Computer-Assisted Intervention for College Students with Autism Spectrum Disorder: Preliminary Support for Feasibility

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Abstract

The number of young adults with Autism Spectrum Disorders (ASD) enrolled in higher education institutions has steadily increased over the last decade. Despite this, there has been little research on how to most effectively support this growing population. The current study presents data from a pilot trial of two novel intervention programs developed for college students with ASD. In this small randomized controlled trial, college students with ASD (n = 8) were assigned to one of two new programs – either an intervention based on a virtual reality–Brain-Computer Interface for ASD (BCI-ASD) or a psychosocial intervention, the College and Living Success (CLS) program. Preliminary evidence supports the feasibility and acceptability of both programs, although behavioral outcomes were inconsistent across participants and interventions. Results indicate that expanded research on psychosocial and computer-assisted intervention approaches for this population is warranted, given the preliminary support found in this pilot study.

The diagnosis and clinical manifestation of ASD persists into adulthood for most affected persons (Billstedt, Gillberg, & Gillberg, 2005; Farley et al., 2009). Better identification and increased rates of diagnosis contribute to a steadily growing population of cognitively

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unimpaired adolescents and adults with ASD (VanBerkgeijk, Klin, & Volkmar, 2008), many of whom are college-bound (White, Ollendick, & Bray, 2011). Despite the increasing number of young people with ASD who are either college-bound or enrolled in college, there have been few academic or clinical interventions (e.g., Hillier, Fish, Siegel, & Beversdorf, 2011; Wenzel & Rowley, 2010) designed to address their unique needs. The current report presents data from a small pilot trial of two novel intervention programs developed for college students with ASD.

Although there is not a well-developed research base on developmental trajectories from adolescence through adulthood for people with ASD, this transition is a period of heightened risk, characterized by decreased structure and insufficient support services (Taylor & Mailick, 2014). Improvement of core ASD symptoms and daily living skills tends to either plateau or regress after adolescence (Smith, Maenner, & Seltzer, 2012; Taylor & Seltzer, 2011). Regardless of cognitive capability to succeed in college, it is generally agreed that students with ASD face specific risks once enrolled, including higher than average rates of drop-out, academic difficulty, social isolation, and secondary psychiatric problems and emotional distress (Smith et al., 2012; VanBergeijk et al., 2008; White et al., 2011). Although the behaviors and skill deficits that may contribute to these outcomes vary across students (Fountain, Winter, & Bearman, 2012), some of the most commonly reported challenges faced by college students with ASD include poor organizational skills, impaired planning (related to poor executive function), impaired time management skills, and poor emotion regulation (Duke, Conner, Kreiser, & White, 2013). Problems related to secondary psychiatric difficulties, such as anxiety and depression (e.g., amotivation), are also common and should be addressed in treatment (Kreiser & White, 2014; Mazefsky & White, 2014).

Emerging adulthood, a developmental period that spans ages 18 to 25 (e.g., Arnett, 2000) and ecompasses the age range of most college students, may be a critical time for targeting many of these challenges (e.g., delayed daily living and emotion regulation skills required for independent living). During this phase of life, most students, including those with ASD, struggle to manage multiple, developmentally salient life tasks, such as academic demands, building intimate relationships, as well as experiencing independent living, apart from their parents for the first time. Recently, some commercial, packaged curricula have been developed to support students with ASD in post-secondary settings (e.g., Achieving in Higher Education: http://www.aheadd.org/; College Living Experience: http://experiencecle.com/). However, such programs generally have a considerable cost to the student [or his/her family], with an average per-semester cost of approximately $3,500. On a more restricted basis, the University of Connecticut offers a first year experience through their disabilities support office, for a modest fee, that is designed to help students with ASD primarily in the social domain (Wenzel & Rowley, 2010). As such, most available programs are accessible only to students and families who can afford them or who are enrolled at a particular school. In general, there is also little research on the clinical impact or consumer acceptability of these programs. Although not examining college students, Hiller and colleagues (2011) reported promising findings in a non-randomized study of a group-based social and vocational skills intervention program for adolescents and young adults with ASD, suggesting that this population desires and can benefit from such intervention.

Most services and supports for college students with special learning or mental health needs come from disability services offices (e.g., academic accommodations, student monitoring; Wolf, Brown, & Bork, 2009), as well as college counseling centers. Individually administered psychosocial interventions such as cognitive-behavioral therapy (CBT) can be resource-intensive (with respect to time and money) and, for students with ASD, difficult to access due to unavailability of clinicians trained to work specifically with clients who have ASD (White, 2012). Technology-based interventions, such as brain-computer interface (BCI)-based applications, may therefore hold considerable promise in terms of increased ease of access as well as clinical efficacy (e.g., Insel & Sahakian, 2012).

Relative to psychosocial interventions, neurotechnological approaches may be preferable to some students with ASD for several reasons. For instance, BCI-based applications provide immediate feedback to the user and minimize extraneous arousal and anxiety that may be related to interacting with other people. People with ASD, in particular, may benefit from computerized interventions because of the highly predictable and controlled delivery format, the ability to work at one's own pace and focus on specific skills, and their cost-efficiency (e.g., one can repetitively use the program [a 'dosage' consideration] without additional cost; e.g., Wainer & Ingersoll, 2011). BCI can be used to monitor a participant's cognitive state and this information can then be used to automatically adjust the information presented to the participant. Virtual reality (VR) can effectively model social situations that occur in real life or replicate laboratory-based tests (Lazem, Gra anin, & Harrison, 2012; Wallegård et al., 2011). Furthermore, VR-based intervention tools (Bellani et al., 2011; El-Shehaly et al., 2013) can facilitate social learning and adoption of new behaviors through modelling such scenarios using virtual agents (Nye & Silverman, 2013). A combination of VR-based intervention tools and BCI allows one to not only measure a person's cognitive state and relate it with the presented social scenario, but also to inform the use of BCI feedback for real-time, adaptive social response via virtual agents (avatars) in VR.

Although neurotechnologies are increasingly available and show promise (White et al., 2014), there have been no direct comparisons of computer-based interventions to psychosocial therapies. Additionally, although students with ASD may prefer computer-assisted intervention, it is plausible that such an approach does not allow the level of support and individualization these students may need. It is important to consider the social validity and feasibility of both modalities as the field more rigorously explores the clinical effectiveness of interventions for this population. Accordingly, we sought to implement two novel intervention programs within the university-setting, one psychosocial and one BCI, developed for postsecondary students with ASD. The purpose of this pilot randomized control trial (RCT) was to examine the feasibility of each intervention model, and, in an exploratory fashion, examine preliminary behavioral outcomes.

The psychosocial program used in this study (College and Living Success: CLS) was designed to target social competence and self-regulation (e.g., time management, emotion regulation). The computerized program (Brain-Computer Interface for ASD: BCI-ASD) targeted social competence, with emphasis on emotion recognition. Two active paradigms were included, rather than a no-treatment control (waiting list) or placebo condition, in order to evaluate the feasibility and social validity of both the psychosocial and technology-based

programs within the same target sample, as there has been no controlled research evaluating separate implementation of both approaches. Although the study was neither intended nor powered to detect statistically significant between-group post-treatment differences, we anticipated that both programs would be associated with improvement across a range of variables (e.g., within-participant improvement). We expected that participants would find both programs acceptable based on consumer satisfaction ratings, and we predicted that the participants in CLS would be more satisfied than those in BCI-ASD given the greater level of support and individualization provided.

Method

This study was approved by the university's ethics review board. A simple randomization approach was used to ensure even allocation across conditions. Students were recruited through the university's office of disability services, via emails and posted fliers. After providing informed consent, participants completed a screening evaluation to determine eligibility. Inclusion critieria required participants to: 1) be at least 18 years of age, 2) be enrolled full-time in coursework and be in good academic standing (so that program involvement would not adversely affect academic performance), 3) meet diagnostic criteria for ASD, confirmed by the Autism Diagnostic Observation Schedue, Second Edition (ADOS-2; Lord et al., 2012) and a brief clinical interview, and 4) be free of other psychopathology warranting more intensive or acute treatment (e.g., suicidality, thought disturbance), as assessed by a semi-structured clinical interview (Anxiety Disorders Interview Schedule for DSM-IV Client version; ADIS-C; Brown, DiNardo, & Barlow, 1994). Participants were paid a small honoraria for assessments completed as part of the study. Students were enrolled at the start of the fall semester and completed endpoint assessments approximately 3.5 months later, toward the end of the same semester.

Participants

The final sample was comprised of five males and three females (Table 1). The sample was primarily Caucasian with one participant self-identified as "Other". There were no group differences in age, $t(6) = 1.11$, p = .17. Academic majors included computer science ($n = 3$), chemistry ($n = 2$), physics and natural sciences ($n = 2$), engineering ($n = 1$), math ($n = 1$), and philosophy ($n = 1$); two participants had dual majors. All participants had pre-existing diagnoses of ASD and all had at least one co-occurring diagnosis, based on clinical interview (ADIS-C; Brown et al., 1994). The most common co-diagnosis was Social Anxiety Disorder (Table 1). At time of enrollment, participants were asked why they were interested in being involved in the project. Three people did not answer the question, four indicated need for help (e.g., to succeed in college, decrease disorganization and social stress, increase stability), and one cited a desire to advance research. Self-reported concerns of the participants at the start of the study included social problems (e.g., uncertainty about how to interpret others, feeling socially awkward), cognitive problems (e.g., poor memory), anxiety and distress (e.g., feeling overwhelmed), and poor time management (e.g., spending too much time on videogames). Figure 1 depicts the flow of participants from initial screening for eligibility through randomization.

Interventions

CLS—A newly developed psychosocial intervention and support program, CLS is theoretically grounded in CBT and mindfulness-acceptance based approaches, in that it combines principles of behavioral change (e.g., psychoeducation, problem-solving) with acknowledging and accepting one's transient feelings as well as personal strengths and difficulties. The program is comprised of three components: individual therapy (to improve emotion regulation, decrease arousal/anxiety, learn time management and social discourse skills), social outings and activities on and off campus (to practice newly acquired skills and conduct exposures to stress-inducing situations), and supportive 'coaching' help (for managing daily problems and demands more effectively). Participants received weekly therapy visits (up to 14 total, to account for semester breaks), approximately bi-weekly scheduled social outings (e.g., dining in a commons area on campus, attending a group of interest, bowling), and supportive coaching (e.g., phone calls to check in on progress toward goals) on an as-needed basis. Whereas the individual therapy visits were focused on skills teaching and practice, the outings offered opportunities to apply the skills in naturalistic settings with peers. Each participant had a primary therapist who delivered selected CLS modules (see Figure 2 for list of modules) and helped coordinate social outings. CLS therapists were doctoral students in a clinical psychology science program under the supervision of the first author; they received individual and group supervision weekly. Total time commitment for the CLS program participant was about 2 hours per week.

BCI-ASD—VR-BCI is a cross-platform intervention, which can be deployed in an immersive virtual environment, or on a dedicated desktop computer or tablet. The BCI-ASD program is intended to help individuals improve their ability to accurately interpret emotional facial expressions and practice social interaction skills. A commodity wireless BCI Device (BrainBand) provided a single channel EEG reading and attention/meditation levels measurements. First, a baseline BCI measurement was conducted (Figure 3), during which participants were asked to maintain a high level of attention and then a high level of meditation for several minutes. Participants received direct feedback (visual or textual) about the attention/meditation level. The next phase used several off-the-shelf game apps where participants interacted with animated characters to follow clues and perform simple tasks (searching for objects). The final phase was interaction with the virtual agents (avatars) in a virtual environment. A participant was represented as an avatar (controlled by the participant using a keyboard and mouse) in the virtual environment. The other avatars were virtual agents controlled by the application. The participant was presented with a scenario describing a typical social situation and related social activites. For example, in a classroom setting scenario the participant had to greet other students (virtual agents), initiate a conversation, ask a question and interact in the virtual environment. BCI feedback was used to automatically adjust the responses provided by virtual agents, primarily by using the attention level, such that higher attention levels triggered less conspicuous social hints and responses by virtual agents. Participants received 10 to 14 weekly sessions, each lasting between 15- to 30-minutes. The intervention was adminisered on a dedicated desktop computer and a tablet in a clinical office setting (same as CLS). The individual (initials; masked for review) assisting participants in the BCI setup at each session was not, however,

a clinician. Total time commitment for BCI-ASD program participants was about 40 minutes per week.

Measures

Barkley Deficits in Executive Functioning Scale (BDEFS; Barkley, 2011)—The 89-item 'long form' of the BDEFS scale yields five factor scores (self-management of time, self-organization (problem-solving), self-restraint, motivation, and regulation of emotion), each of which is theoretically related to executive function, or the ability to regulate behavior over time in the service of attaining one's goals (Barkley, 2011). Higher scores reflect more impairment. Previous studies have indicated that the BDEFS has acceptable internal consistency (with alpha above .80 for each of the scales) and test-retest stability (Barkley, 2011). In the present study's sample, alpha was above .80 for all scales except regulation of emotion (alpha = .79). The BDEFS was used in the present study as the CLS program's target behaviors included time-management and emotion regulation.

Clinical Global Impression-Improvement (CGI-I; Guy, 1976)—The CGI-I was completed by a clinician unfamiliar with the treatment protocol and uninformed of condition assignment (i.e., an independent evaluator). In this study, the CGI-I represents a very high criterion for improvement, as improvement ratings reflect overall functioning (e.g., daily living skills, academic performance), not just domains covered in the interventions (e.g., social functioning, emotion regulation). Ratings were made on the basis of all available data, including self-report measures, interviews, and observations. The assessor was trained to a pre-set reliability standard (i.e., within one point of pre-established 'gold standard' ratings) to assign improvement ratings.

College Living Experience Satisfaction Scale (I-CLE Satisfaction Scale)— Participant satisfaction was evaluated after completion of the interventions. The I-CLE Satisfaction Scale is a 10-point (1= "not at all helpful", 5= "pretty helpful", 10= "very helpful") scale designed by the authors to measure overall helpfulness of the program.

Student Adaptation to College Questionnaire (SACQ; Baker & Siryk, 1999)— Designed to assess student adjustment across four domains (academic, social, personal-emotional, and goal commitment), the SACQ is comprised of 67 items, each of which is rated on 9-point scale. Higher scores reflect better adjustment to college. The scale's alpha has been found to range from .77 to .95 (Baker & Siryk, 1999). In the present study's sample, alpha was .96. The SACQ was used to evaluate change in participants' self-reported sense of adjustment to college before and immediately following the intervention.

Data Analysis

Feasibility and Social Validity

We first examined ease of recruitment and reasons provided by the participants for being involved in the study. Attendance and participation were evaluated by averaging across participants the number of sessions attended, the length of the sessions, and the number of social outings attended (for CLS). Retention was assessed by examining percentage of

dropouts during treatment. To quantify participant satisfaction, treatment satisfaction ratings were averaged across all individuals.

Efficacy: Behavioral data

All data analyses were conducted in SPSS Version 21. The CGI-I was used to assess change in global functioning from baseline to endpoint. Participants with CGI-I ratings of 1, 2, and 3 (i.e. "very much" improved, "much" improved, or "minimally" improved) were considered treatment responders, and participants with CGI-I ratings of 4 (i.e. "no change") or higher were considered non-responders. CGI-I data were analyzed using a chi-square test. Reliable change indices (RCI; Jacobson & Truax, 1991) were used to calculate significance of change at the individual participant level from baseline to midpoint and baseline to endpoint on the BDEFS and SACQ. The absolute value of RCI scores greater than 1.96 indicated statistically significant change. Mean-level change across the two groups was evaluated with paired samples t-tests.

Results

Feasibility and Social Validity

Interest level among students with ASD is an important component of overall social validity, as no program will be successful if the target population is not interested and does not participate in it. A minimum of six eligible students were sought. Reflective of the interest among the eligible students, eight students were enrolled into the study in a two-week period at the start of the academic semester. A ninth student wanted to enroll but did not meet all study inclusion criteria (ASD diagnosis could not be independently confirmed with ADOS). During the semester-long program, there were no dropouts from either program. Moreover, all enrolled students (one student graduated after fall semester) opted to participate in the other, non-assigned intervention. The BCI-ASD participants completed an average of 11.75 (SD = 1.71) sessions (range = 10–14), and sessions lasted an average of 38.94 minutes (SD = 10.62; range = 19–63). The CLS participants attended an average of 12.75 sessions (SD = 1.26; range = 11–14), which lasted, on average, 60.02 minutes (SD = 1.63; range = 50–77). Therapists administered a majority of the available treatment modules (M = 9.0, SD = 0.812; range = 8–10). Although therapists aimed to complete one module during each treatment session, the flexible nature of the intervention allowed modules to be repeated on an as-needed basis. All participants in CLS engaged in several social outings within the community (M = 6, SD = 1.63; range = 4–8) with their therapist.

All participants responded to a 10-point (1 = not helpful, 10 = very helpful) program satisfaction scale after completing their assigned treatment. As hypothesized, participants in the CLS intervention expressed somewhat greater satisfaction with the program (M = 6.50, SD = 0.58) than participants in the BCI-ASD intervention (M = 4.75, SD = 2.06), although the difference was not statistically significant, $t(6)$ = 1.64, p = .15. Qualitative feedback indicated that the CLS participants found the following aspects of the program most helpful: the weekly social coaching to monitor progress; having someone to talk to one-on-one, which increased awareness of communication skills; and that the program addressed goals self-identified by the participant. In response to being asked what was less helpful,

participants of CLS indicated that they would like more time spent on addressing stress and anxiety management, less time on assessment, and more personalization of the topics addressed in therapy. One BCI-ASD participant indicated that more time practicing with the games could be helpful in improving ability to identify important details in the virtual scenes. No other comments, on either program, were offered by participants.

Behavioral Outcomes

There were two responders to treatment in each condition, and thus no significant difference between condition with respect to response to treatment based on the CGI-I scale, $\chi^2[1] = 0.00$, $p = 1.00$. As a whole, there was no significant improvement in executive functioning from pre- to post- for either intervention for any participants on the self regulation of emotion subscale, the self-management to time subscale, self-restraint, motivation, or total executive function as measured by the BDEFS. One participant in the BCI-ASD condition showed significant improvement on the self-organization/problem-solving scale of the BDEFS, whereas two participants – one from each intervention, showed significant decline on this scale. There was no clinically meaningful improvement or worsening in any of the BDEFS scales for the participants in either intervention. Mean scores over time on the BDEFS for the two treatment conditions are presented in Table 2. Within group, participants in the BCI-ASD showed significantly more problems after the intervention, compared to pre-treatment, in the BDEFS domains of self-management to time ($t[3] = 3.67$, $p = .035$) and motivation ($t[3] = 5.56$, $p = .012$).

Unexpectedly, based on RCI scores, two CLS participants and two BCI-ASD participants showed significant decline in overall adaptation on the SACQ, and one BCI-ASD participant demonstrated significant improvement in overall adaptation to college during the intervention period. Two BCI-ASD participants showed significant decline in academic adjustment. One BCI-ASD participant and two CLS participants showed significant decline (worsening) in attachment, while one BCI-ASD participant improved in this domain. One CLS and one BCI-ASD participant showed significant decline on personal-emotional adjustment. One BCI-ASD participant showed significant improvement in social adjustment, whereas one CLS and two BCI-ASD participants showed significant decline. There was no clinically meaningful change on overall adaptation to college, academic adjustment, attachment, personal-emotional adjustment, and social adjustment for any participant.

Discussion

The number of college-enrolled and college-bound adolescents and young adults with ASD is on an upward trajectory, yet there has been very little research on how to support these students to improve likelihood of academic and social success. We developed two new interventions designed to help college students with ASD navigate social situations and manage stress. We evaluated the feasibility and preliminary efficacy via a pilot RCT. Interest in both programs was high, and we surpassed our enrollment goal within two weeks. Both programs were implemented as intended, without adverse events or protocol deviations. Throughout the semester-long intervention, there were no dropouts from either program.

Consumer satisfaction was moderate to high for both programs, with slightly higher (though not statistically significant) satisfaction for the CLS participants.

Due to the small sample size, we are not able to draw firm conclusions about the preliminary efficacy of either program. No uniform pattern (improvement or worsening) across participants or conditions was apparent in the domains of college adjustment or executive functioning. Apart from the small sample size, there are other limitations to note. Caution must be used when comparing the two intervention programs. The content of the programs, with respect to deficits and skills addressed, is not identical. Moreover, the CLS program offered a 'higher dosage' intervention. Participants in CLS attended an average of 12.75, 60-minute sessions (not including the outings or the weekly coaching), whereas those in the BCI-ASD program received an average of 11.75, 38-minute sessions. There was no traditional control group, making it impossible to assess whether observed changes across the two active programs are due to the intervention rather than a factor unrelated to treatment. Third, the post-intervention assessments took place at the end of the semester, during final examinations, whereas the pre-intervention assessments took place either before the start of the semester or during the first week of classes. These time points are periods of relative high and low stress, respectively, and it is conceivable that this confound influenced the outcome data. Although there are no published data on within-term changes in SACQ scores, there is evidence of declining scores, indicating lower adjustment, at mid-semester relative to the summer prior to matriculation (Baker & Siryk, 1999). Inclusion of a no-intervention control group would have helped to determine the degree to which observed changes were reflective of heightened stress and demands over the course of the academic semester. Related to this, most of our outcomes are based on self-report data rather than objective indicators. It is possible that participation in either program served to increase participants' awareness of difficulties (e.g., with time management), regardless of whether or not a true change in the specific behavior occurred, which may explain the observed worsening in some domains from pre- to post-intervention.

These limitations notwithstanding, this is the first published RCT, to the authors' knowledge, of any support or intervention program developed explicitly for college students with ASD. Moreover, we compared two unique, active interventions in this study. Results indicate that both psychosocial and computerized interventions for college students with ASD are feasible to implement and are acceptable to consumers. Additionally, participant enrollment and randomization was successful. As noted by trial methodologists, assessment of these elements is the primary impetus for pilot studies in clinical research, and demonstration of such is necessary for subsequent efficacy-testing clinical trials (Leon, Davis, & Kraemer, 2011).

Although behavioral outcome data from this pilot are equivocal, the programs are feasible to implement and socially valid for this population. As such, larger scale development efforts and clinical evaluation of psychosocial and computer-based interventions for college students with ASD is deemed warranted. Indeed, we are now conducting a more rigorously controlled clinical trial to evaluate the efficacy of the psychosocial program. Although neurotechnologies such as BCI are not yet widely available as intervention tools, this study adds to a growing body of research suggesting further development and evaluation of such

approaches. We do not, however, envision computer-based appraoches replacing more traditional, student-focused or group-based services and interventions. This study's findings suggest that college students with ASD enjoy, and often derive benefits from, individualized support. As such, programs that combine technology with psychosocial intervention may allow for optimum individualization in the context of transportability, dissemination, and ease of use. In addition, future research will need to explore how best to match approach (e.g., computer-based, in-person) to the student to optimize outcome.

Acknowledgments

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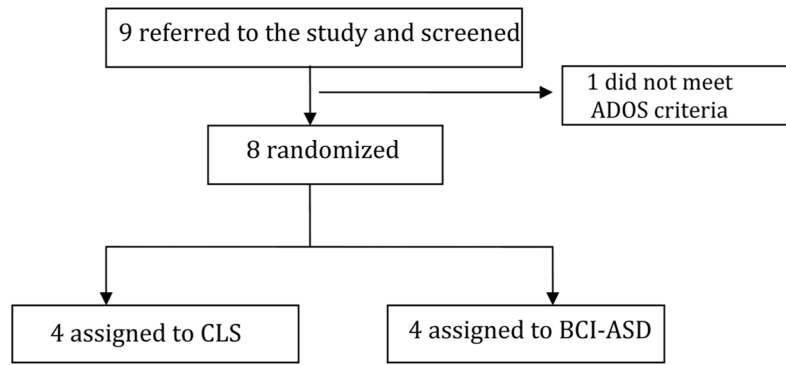
Figure 1.
CONSORT flow chart of participants.

➢ Orientation to CLS & Psychoeducation about ASD
➢ Changing Thought Patterns and Increasing Flexibility
➢ Independent Adulthood
➢ Problem-Solving I
➢ Problem-Solving II
➢ Acceptance, Change, and Emotion Regulation
➢ Meeting New People
➢ Healthy Stress Management
➢ Emotion Regulation I
➢ Emotion Regulation II
➢ Wrap-up and Therapy Termination

Figure 2.
CLS therapy modules.

Figure 3.
BCI baseline measurement.

TABLE 1

Demographic characteristics of sample (n = 8)

	CLS			BCI		
	M (SD)	Range	n (%)	M (SD)	Range	n (%)
Age	20.25 (1.71)	18–22		20.75 (1.71)	19–23	
IQ[a]	115.75 (22.28)	86–140		126.75 (5.62)	121–134	
Year in school						
1st			1 (25)			0 (00)
2nd			0 (00)			1 (25)
3rd			1 (25)			2 (50)
4th +			2 (50)			1 (25)
Diagnoses *						
PD			1 (25)			1 (25.0)
Agoraphobia			0 (00)			1 (25)
SAD			3 (75)			4 (100)
GAD			2 (50)			2 (50.0)
OCD			0 (00)			3 (75)
SP[b]			3 (00)			2 (50)
PTSD			0 (00)			0 (0)
Depression			1 (25)			0 (00)
Dysthymia			1 (25)			2 (50)

*
PD = Panic Disorder; SAD = Social Anxiety Disorder; GAD = Generalized Anxiety Disorder; OCD = Obsessive-Compulsive Disorder; SP = Specific Phobia; PTSD = Post-Traumatic Stress Disorder.

[a]
IQ based on 4-subtest WASI (two participants had 2-subtest WASI).

[b]
SP: includes multiple SPs.

TABLE 2

Pre- and post-intervention descriptive statistics and change scores

	BDEFS[a]						SACQ[b]				
	Total	SM	SO	SR	SMot	EmotR	Total	AA	SA	PEA	A
BCI-ASD											
Pre-intervention	191.25 (43.78)	53.25 (11.93)	56 (17.80)	32.25 (7.46)	21.25 (7.41)	28.5 (8.19)	351.75 (103.55)	130.75 (28.29)	95.00 (38.08)	71.75 (24.39)	87.50 (27.35)
Post-intervention	203.75 (32.29)	58.75 (12.71)	58.5 (9.11)	33.25 (5.85)	27.25 (7.36)	26 (8.37)	319.00 (78.67)	115.25 (29.09)	88.50 (25.96)	63.25 (25.18)	83.50 (21.76)
Change	−12.50	−5.50*	−2.50	−1.00	−6.00*	2.50	32.75	15.50	6.50	8.50	4.00
CLS											
Pre-intervention	156.75 (34.2)	41.25 (11.44)	48 (14.54)	27.25 (5.06)	17.5 (5.80)	22.75 (3.40)	413.25 (85.94)	142.75 (38.12)	131 (28.58)	86.0 (22.32)	106.0 (15.17)
Post-intervention	157.5 (47.35)	41.25 (15.33)	48.25 (19.17)	27 (4.69)	20.5 (5.45)	20.5 (5.45)	388.50 (111.52)	134.5 (43.09)	120.25 (38.77)	79.25 (18.52)	93.00 (25.31)
Change	−0.75	0.00	−0.25	0.25	−3.00	2.25	24.75	8.25	10.75	6.75	13

*
$p < .05$.

[a]On BDEFS, negative change score indicates worsening and positive change score indicates improvement.

[b]On SACQ, negative change score indicates improvement and positive score indicates worsening.

SM: Self-Management to Time, SO: Self-Organization, SR: Self-Restraint, SMot: Self-Motivation, AA: Academic Adjustment, EmotR: Self-Regulation of Emotion, SA: Social Adjustment, PEA: Personal-Emotional Adjustment, A: Attachment.