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# Peers, Play, and Performance to Build Social Salience in Autistic Youth: A Multisite Randomized Clinical Trial

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**Objective:** Individuals with autism spectrum disorder (ASD) have significant impairment in social competence and reduced social salience. SENSE Theatre, a peer-mediated, theater-based intervention has demonstrated posttreatment gains in face memory and social communication. The multisite randomized clinical trial compared the Experimental (EXP; SENSE Theatre) to an Active Control Condition (ACC; Tackling Teenage Training, TTT) at pretest, posttest, and follow-up. It was hypothesized that the EXP group would demonstrate greater incidental face memory (IFM) and better social behavior (interaction with novel peers) and social functioning (social engagement in daily life) than the ACC group, and posttest IFM would mediate the treatment effect on follow-up social behavior and functioning. **Method:** Two hundred ninety participants were randomized to EXP ( $N = 144$ ) or ACC ( $N = 146$ ). Per protocol sample ( $\geq 7/10$  sessions) resulted in 207 autistic children 10–16 years. Event-related potentials measured IFM. Naive examiners measured social behavior (Vocal Expressiveness, Quality of Rapport, Social Anxiety) and functioning (Social Communication). Structural equation modeling was used to assess treatment effects. **Results:** SENSE Theatre participants showed significantly better IFM ( $b = .874, p = .039$ ) at posttest, and significant indirect effects on follow-up Vocal Expressiveness  $a \times b = .064$ , with 90% CI [.014, .118] and Quality of Rapport  $a \times b = .032$ , with 90% CI [.002, .087] through posttest IFM. **Conclusions:** SENSE Theatre increases social salience as reflected by IFM, which in turn affected Vocal Expressiveness and Quality of Rapport. Results indicate that a neural mechanism supporting social cognition and driven by social salience is engaged by the treatment and has a generalized, indirect effect on clinically meaningful functional outcomes related to core symptoms of autism.

## What is the public health significance of this article?

Few treatments exist to target social competence in autism. The present study provides compelling evidence for a peer-mediated, theater-based treatment to enhance salience of social stimuli that over time increases spontaneous social behavior.

**Keywords:** autism, social competence, event-related potentials, social salience

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*continued*

Individuals with autism spectrum disorder (ASD)<sup>1</sup> have significant impairment in social competence (American Psychiatric Association, 2013), which is the ability to independently and appropriately engage with others in social interactions and across contexts (Bauminger et al., 2003; Stichter et al., 2010). Social competence relies on a complex neural network of cognitive, emotional, and behavioral systems in which perception and behavior are causally linked (Adolphs, 2001). Deficits in social cognition, including face memory (Suri et al., 2021), and executive function (Demetriou et al., 2018) are frequently found in youth with autism and tied to social deficits (Leung et al., 2016). Interventions intended to remediate core symptoms in ASD may benefit from a social competence framework to guide the understanding, measurement, and treatment. Social salience is the extent to which a stimulus draws the attention of an observer with the idea that items with greater social salience would attract more attention and be processed to a greater extent. Therefore, interventions that enhance social salience may in turn facilitate performance in social cognition (e.g., face memory) and behavior (Chevallier et al., 2012). Most social interventions to date have relied on didactic skills-based instruction rather than being tethered to a mechanism empirically linked in these fundamental social cognition deficits.

Despite progress to improve social skills for individuals with ASD, (DeRosier et al., 2011; Ichikawa et al., 2013; D. Kamps et al., 2015; Solomon et al., 2004; Soorya et al., 2015), relatively few well-conducted randomized clinical trials (RCTs) have shown generalized or maintained effect, especially on skills not directly taught (DiSalvo & Oswald, 2002; Hirvikoski et al., 2015; Laugeson et al., 2012; Lopata et al., 2019; Rao et al., 2008; White et al., 2013). One reason may be the focus on specific social skills rather than on targeting underlying mechanisms and the omission of treatment components that may help maintain and generalize skills to other people and contexts (Lerner et al., 2012). Additionally, the majority of group social skills interventions are knowledge-based with a primary focus on didactic training of specific skills, as opposed to performance-based, which focus on providing opportunities for application of various social skills in practice, with less focus on explicit skill training (Lerner & Mikami, 2012). In fact, self-advocates and proponents of the broader neurodiversity initiative have suggested that social skills-based interventions are problematic in that they promote masking symptoms in order to “fit in” to neurotypical environments (Collective, 2022). Such suppression of behaviors or ASD symptoms has been linked to a host of problems such as depression and anxiety, as well as autistic burnout (Raymaker et al., 2020). There is also an over-reliance on parent-report measures as outcome measures for social skills interventions, which are prone to expectancy bias (Wolstencroft et al., 2018) as well as a paucity of follow-up measures to examine maintenance (Hirvikoski et al., 2015).

Another important consideration is how the social skills intervention is delivered. While underutilized, the inclusion of trained peers in social skills interventions has been shown to be beneficial (Lang et al., 2011; Odom & Strain, 1984), contributing to generalization of skills (D. M. Kamps et al., 1992) and peer acceptance (Kasari et al., 2012). Rather than focusing on didactic instruction, inclusion of peer models fosters learning and application of social skills in real-time, and peer-mediation has shown to be highly effective in improving variety of skills in children with autism (Banda et al., 2010; DiSalvo & Oswald, 2002; D. M. Kamps et al., 1992; Kasari et al., 2012; Lang et al., 2011; Laugeson et al., 2012; Odom & Strain, 1984; Prendeville et al., 2006; White et al., 2013). Trained youth actors may be considered a unique type of peer serving as an expert model of reciprocal social communication. Additionally, theater as a form of intervention to enhance social functioning has shown promise for individuals with typical development (TD) and ASD (Corbett, Swain, et al., 2014; Corbett et al., 2011; T. R. Goldstein, 2011; H. Goldstein & Cisar, 1992; Lerner et al., 2011; B. J. Webb et al., 2004; Williams, 1989). Acting involves perceiving, engaging, and expressing thoughts and feelings (Corbett et al., 2016), which are components of social communication. Thus, interacting with socially competent peer actors using theater techniques has the potential to target many aspects of social competence, including social cognition, social interaction, and social communication (Corbett, Swain, et al., 2014). Intervention studies employing various theatrical approaches (e.g., role-playing, improvisation, thematic play) have reported changes in communication, perspective taking, and adaptive functioning (Beadle-Brown et al., 2018; Corbett et al., 2011); unfortunately, the majority of studies lacked scientific rigor (e.g., small samples sizes, pretest posttest design, primarily parent reports; Beadle-Brown et al., 2018; Corbett et al., 2011) with only a few studies including a control group (Reading et al., 2016), and more rigorous RCT designs (Corbett et al., 2016, 2019; Ioannou et al., 2020).

SENSE Theatre incorporates peers, play, and performance to enhance social competence. This approach is distinct from established social interventions that rely on skills training and practice. Peer mediation provides supportive, expert models of reciprocal social communication, and theatrical play facilitates motivation to interact with others in novel, spontaneous, and engaging ways. Performance provides the opportunity to explore and practice newly learned skills

<sup>1</sup> At the time of writing this article, there is debate regarding the use of terminology and whether *person-first* language in which the individual (e.g., adolescent) is referenced before the condition (e.g., autism) or whether *identity-first* language (e.g., autistic adolescent) should be used. Because such issues have not been resolved, we have opted to take a mixed terminology approach. Similarly, we will use the terms *autism*, *autism spectrum disorder*, and *autistic* interchangeably.

an equal role in project administration, supervision and validation. Jennifer Pilkington played an equal role in supervision, and validation. Philip Gable played a supporting role in resources and writing-review and editing. Ayla Gioia played a supporting role in data curation and an equal role in project administration. Alexandra P. Key played a lead role in methodology and resources and an equal role in investigation and writing-review and editing.

The trial was preregistered with <https://ClinicalTrials.gov> (Identifier: NCT03368001).

Data collected for the study have been submitted to the National Database for Autism Research (NDAR) via the following URL at [https://nda.nih.gov/edit\\_collection.html?id=2866](https://nda.nih.gov/edit_collection.html?id=2866). The NDAR repository sets standard criteria for accessing data. The study protocol is available upon request to Blythe A. Corbett.

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in a unique and encouraging learning environment (Corbett, Qualls, et al., 2014; Corbett, Swain, et al., 2014; Corbett et al., 2011). It has been postulated that momentary social motivation is enhanced through the active use of improvisation, theater games, joke time, peer engagement exercises, and role plays (Corbett, Qualls, et al., 2014; LeGoff, 2004), thereby increasing social and learning opportunities. Youth in SENSE Theatre have shown posttreatment gains in face memory, theory of mind, social communication, increased play behavior with novel peers (Corbett et al., 2011, 2016; Corbett, Qualls, et al., 2014; Corbett, Swain, et al., 2014) as well as reduction in self-reported trait anxiety (Corbett et al., 2017).

Previous research has also shown that SENSE Theatre was associated with improvements in incidental face memory (IFM) reflected by changes in brain activity measured by event-related potentials (ERPs; Corbett et al., 2016). Forming a memory trace following repeated exposure to novel faces, without explicit instructions to attend to or memorize the stimuli, reflects greater spontaneous attention allocation to salient social cues. Recording brain activity during the IFM paradigm removes the need for overt behavioral responses, making it a passive task, and therefore avoiding the potential confounds with executive function difficulty frequently reported in ASD (Demetriou et al., 2018). Taken together, brain and behavioral findings suggests that increases in salience of social stimuli and associated motivation may occur following social success experienced during SENSE Theatre activities.

While the previous findings are promising, there were limitations, including: (a) the maintained group effects were primarily detected on parent-reports or social interaction by coders who could have known treatment assignment, (b) most studies involved a single cohort, (c) the use of a waitlist control group rather than comparison to another treatment, and (d) previous studies were conducted by the developer team at a single site. Therefore, a stronger test of SENSE Theatre efficacy was needed (American Psychological Association, Presidential Task Force on Evidence-Based Practice, 2006; Wong et al., 2015). The present study addresses these limitations via (a) recruiting a much larger sample, (b) measuring generalization and maintenance of treatment effects using examiners and coders blind to treatment group, (c) a randomized control design involving multiple cohorts, (d) comparison of the treatment to an Active Control Condition (ACC), and (e) implementation at three sites—Vanderbilt University Medical Center (VUMC), University of Alabama (UA), and Stony Brook University (SBU)—thus, expanding the basis for inferring transferability of the treatment. Moreover, a test of whether face memory mediates the treatment effect on social competence was planned to shed light on one of the reasons SENSE Theatre may facilitate social development.

The following aims and hypotheses were made. Hypothesis 1: Youth in the Experimental (EXP) group will demonstrate significantly greater posttest IFM (using ERP) than the ACC group. Hypothesis 2.1a: Youth in the EXP group will demonstrate significantly better posttest social behavior than youth in the ACC group (i.e., Quality of Rapport, Vocal Expressiveness and Social Anxiety). Hypothesis 2.1b: Youth in the EXP group will demonstrate significantly better posttest social functioning (Social Responsiveness Scale Social Communication) than youth in the ACC group. Hypothesis 2.2a: Posttest Incidental Face Memory (ERP) will mediate the treatment effect on follow-up social behavior. Hypothesis 2.2b: Posttest Incidental Face Memory (ERP) will mediate the treatment effect on follow-up social functioning.

## Method

The research was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). The VUMC Institutional Review Board approved the study. Informed written consent and assent were obtained from all parents and study participants, respectively, prior to inclusion in the study.

## Transparency and Openness

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study. The study was preregistered with <https://ClinicalTrials.gov> (NCT03368001). Portions of the baseline data have been published elsewhere (see Appendix).

## Participants

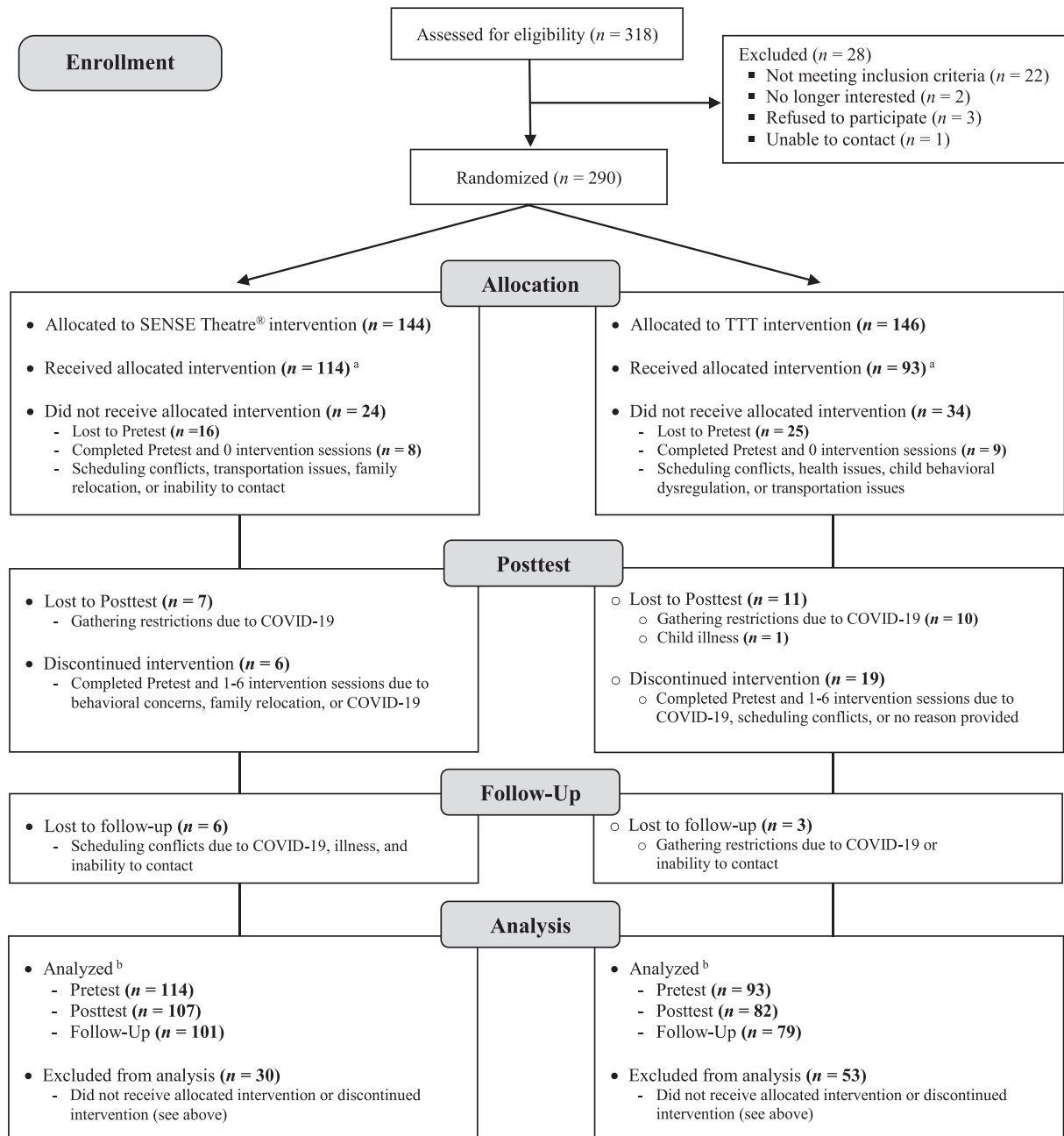
Participants were recruited from a broad community sample that targeted medical and health-related services, clinics, research registries, regional autism/disability organizations, schools, and social media platforms. Inclusion criteria for the sample required a confirmed diagnosis of ASD based on the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (American Psychiatric Association, 2013) at each site and corroborated by the Autism Diagnostic Observation Schedule—2 Module 3 (Lord et al., 2012). Inclusion criteria also required an intelligence quotient (IQ) score  $\geq 70$ , any exceptions were determined based on consensus by all site leaders. In addition to the criteria above, to maintain safety for all, youth were excluded if they had a recent (within the past 6 months) and significant history of parent-reported physical aggression toward others or property destruction. The eligible sample consisted of 290 participants randomized to EXP ( $N = 144$ ) or ACC ( $N = 146$ ); however, analyses were conducted on participants who completed a per protocol number of  $\geq 7$  of 10 sessions (see Consolidated Standards of Reporting Trials Diagram Figure 1 for details), which resulted in a final sample of 207 participants. This approach was adopted as a consequence of the COVID-19 pandemic and data loss of primary variables. The demographic data are presented in Table 1. There were no site differences on basic demographic data. The mean age was 12.62 years across both groups. The sex distribution was 60 (29%) females and 147 (71%) males. The racial and ethnic characterization of the sample was comprised of 9.7% Black, 78.7% White, 3.9% Asian, 0.5% American Indian, and 7.2% multiracial. There were 7.2% Hispanic and 92.8% non-Hispanic participants. As expected, there were site differences based on race,  $\chi^2(8, 207) = 17.51, p = .02$ . Percentage for each site were as follows: Black (VUMC = 7.8%, UA = 19.6%, SBU = 3.3%), White (VUMC = 81.1%, UA = 75.0%, SBU = 78.7%), Asian (VUMC = 4.4%, UA = 0.0%, SBU = 6.6%), American Indian (VUMC = 0.0%, UA = 1.8%, SBU = 0.0%), multiracial (VUMC = 6.7%, UA = 3.6%, SBU = 11.5%).

Across the three sites (VUMC, UA, and SBU) there were an intended 4 cohorts each consisting of an EXP and ACC group. Due to the pandemic, the SBU site was only able to complete 3 cohorts; thus, an additional cohort was added to the VUMC site.

## Diagnostic Procedures

The diagnosis of ASD was based on the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (American

**Figure 1**  
*CONSORT Diagram*



*Note.* SENSE = SENSE Theatre; TTT = Tackling Teenage Training; CONSORT = Consolidated Standards of Reporting Trials; DV = Dependent Variable.

<sup>a</sup> Completed “per protocol” intervention (i.e., attended  $\geq 7$  intervention sessions). <sup>b</sup> Data from subjects who completed “per protocol” intervention and at least one Primary or Secondary DV at Pretest, Posttest, or Follow-Up.

Psychiatric Association, 2013) and confirmed by a psychologist with autism expertise, current clinical judgment by a study team member, and corroborated by the Autism Diagnostic Observation Schedule–Second Edition (ADOS-2; Lord et al., 2012).

*Autism Diagnostic Observation Schedule–Second Edition* (ADOS-2; Lord et al., 2012) is a semistructured interactive play and interview-

based instrument used to support the diagnosis of ASD. The ADOS-2 Module 3 was administered by research-reliable personnel and a minimum raw total score of 7 was required for inclusion.

*Wechsler Abbreviated Scale of Intelligence–Second Edition* (WASI-II, (Wechsler, 2011) is a measure of cognitive ability used to obtain an estimate of the youth’s intellectual functioning ( $IQ \geq 70$



**Table 1**  
*Descriptive Statistics*

Variable	N	SENSE (N = 114)		TTT (N = 93)		Test statistic	p value
		M	SD	M	SD		
Age	207	12.62	1.86	12.62	1.98	0.002	.998
Verbal IQ	206	100.13	19.85	98.11	18.03	0.744	.457
Performance IQ	206	98.03	19.99	97.54	17.31	0.183	.855
Full scale IQ	207	99.32	19.25	97.28	17.99	0.780	.437
ADOS severity	207	7.25	1.94	7.52	1.91	-1.008	.315

*Note.* SENSE = SENSE Theatre; TTT = Tackling Teenage Training; IQ = intelligence quotient; ADOS Severity Score = Autism Diagnostic Observation Schedule Severity Score.

required to participate in the study<sup>2</sup>). The psychometric properties of the WASI are strong (test–retest reliability 0.83–0.94 for the subtests, and 0.90–0.96 for the composite scores).

## Interventions

The study design consisted of a two-arm parallel group RCT with EXP (SENSE Theatre) and ACC (Tackling Teenage Training [TTT]) groups.

### *Experimental Condition: SENSE Theatre*

SENSE Theatre is a peer-mediated, theater-based intervention targeting social competence for youth with ASD. The manual describes the delivery of systematic techniques while permitting individualization based on developmental readiness of the child (Kasari & Lawton, 2010). The rehearsal schedule spans 10 sessions lasting approximately 3 hr per day once a week (i.e., Saturday) as well as 2 days of technical rehearsals, which culminates in the performance of a 45-min play. Activities include role-play, character development, singing, basic choreography and improvisation. The core objectives include 10 overarching principles that the peers learn and model through engagement with ASD participants: (1) *Provide social support* (e.g., shared understanding, acceptance), (2) *Create a fun, enjoyable and playful environment* (positive affect, provide humor), (3) *Model warm, appropriate social interaction* (establish rapport, smile), (4) *Encourage and motivate interaction using behavioral techniques* (praise, applause), (5) *Engage in directed communication* (eye contact, show intent), (6) *Use gestures* (instrumental, informational) and *nonverbal communication* (facial expression, body movements) in directed ways to enhance social interaction, (7) *Engage in imaginative play* (think aloud, role-play), (8) *Show empathic responding* (active listening, emotional mirroring), (9) *Support learning as an active process* (show, recreate through action), (10) *Advance learning* (shaping, introduce next steps).

SENSE Theatre is peer-mediated by young actors or peers skilled in social communication who are matched 1:1 with an autistic participant. Peers were recruited from area schools, theater programs, community events, and social media outreach efforts. Following an interview to ascertain genuine interest and experience in working with children, selected peers undergo comprehensive training on autism, behavioral intervention techniques (e.g., positive reinforcement, extinction), and the SENSE Theatre core objectives. Peers are matched with participants based on qualification, experience, and age

with the aim of best supporting the needs and characteristics of the participant. At all times, peers and participants are supervised by clinical research staff (e.g., licensed clinical psychologist, psychology intern, postdoctoral fellow, speech, and language pathologist), while the Theatre Director provides structure to each session (e.g., moving from joke time to vocal practice). The plays are original 45-min copyrighted productions, that include individual roles for each participant and peer and focus on topics relevant to the challenges of ASD. Participants are cast alongside peers in roles commensurate with their ability and are flexible to individualize the character and to meet the skills of the participant.

### *Active Control Condition: Tackling Teenage Training*

The ACC is approximately equivalent to SENSE Theatre in most of the “nonspecific” and common treatment factors (Kazdin, 2002): (a) session frequency and length (i.e., once per week for 2½–3 hr for 10 sessions), (b) peer contact and socialization opportunity (i.e., involvement of 2–3 typically developing similar age peers), and (c) clinician attention (i.e., group facilitators will have similar training, experience, and supervision). We modified the TTT program (Dekker et al., 2015) developed for autistic people. We chose the TTT because it possesses the essential factors desirable in an ACC (e.g., [Kazdin, 2002]), including equivalence in format, duration, and intensity while simultaneously not possessing the purported active ingredients of the experimental treatment (e.g., strategies to promote social cognition). RCTs of the TTT have shown promise (Dekker et al., 2015; Visser et al., 2017) and effectiveness in behavioral and cognitive outcomes related to sexual intimacy and interpersonal boundaries for younger adolescents (Visser et al., 2017). Modifications (approved via personal communication with developer) include a few TD peers in a group format, and omission of sessions content that was developmentally inappropriate for children under age 12. Sessions included topics related to appearances, first impressions, how to become friends, how to maintain friends, setting boundaries, respecting boundaries, and safe internet use. Session activities include didactic instruction, conversation, and practice (e.g., via role-play). A previous study with teens ( $n = 95$ ) with ASD (Visser et al., 2017) reported a high retention rate (>87%) and satisfaction ratings with the program.

### **Rigor and Reproducibility**

A comprehensive model related to design, training, and delivery fidelity was used (Ory et al., 2002). Design fidelity was addressed by the utilization of clinicians and outlined sessions and training logs. Training fidelity, for SENSE Theatre, was tested by an exam containing 20 questions pertaining to basic knowledge of autism and behavioral methods conducted at the beginning and the end of the training. Delivery fidelity, for both EXP and ACC conditions, was conducted by observing peer/clinician implementation during 50% of the sessions throughout the treatment and rated based on core objectives and techniques using a behaviorally anchored 5-point Likert scale reported as percentages (Fidelity measures available upon request).

<sup>2</sup> Participants with a subdomain index score < 70 were included based on clinical judgment.

To produce balanced baseline characteristics while managing resources, a randomly selected block size, block-randomization method was used to randomly assign participants to one of the two treatments (Efird, 2011). No additional factors (e.g., age, sex) were added to the block-randomization. Coding of behavioral responses was conducted by trained examiners naïve to treatment assignment. Families were asked to keep nonproject treatments stable for at least 1 month prior and without anticipated changes in the frequency or intensity of these treatments throughout the duration of the study.

After the initial eligibility visit in which diagnosis was confirmed, the study design included three measurement periods in which the dependent variables (DVs) were collected: (a) pretest, (b) posttest, 10 weeks after pretest, and (c) follow-up 2 months after the posttest.

## Primary Outcome Measure

### *Incidental Face Memory*

ERPs are a promising source of neurophysiological markers for detecting treatment effects (Javitt et al., 2008). Previously, a visual ERP paradigm was developed to examine IFM resulting from repeated exposures to a face presented among unique novel face distractors (Key & Corbett, 2014).

The IFM paradigm involves presentation of 50 unfamiliar faces, each seen once (single presentation, 50 trials), and one unfamiliar face presented 50 times (repeated presentation; 50 trials) throughout the test session. A parallel set of repeated and single trials using pictures of houses serves as a control condition but was not used in analysis. The social and nonsocial trials are presented in random order for 1,500 ms each with a varied interstimulus interval of 1,300–1,600 ms. Participants are instructed to view the pictures but are not informed about the repeating stimuli. The paradigm capitalizes on prior ERP studies examining stimulus repetition effects. Repeated (“old”) stimuli elicit more positive parietal ERP amplitudes than single (“new”) items (also known as the “old/new effect” [Curran & Cleary, 2003; Duarte et al., 2004]), which reflects recall of information (Nessler et al., 2001; Wilding, 2000) and greater depth of cognitive processing (Rugg et al., 2000). Repetition-related enhancement of brain activity has been also observed in fMRI studies in cases of increased attention to the stimuli or incidental recollection of the repeated items (see (Segaert et al., 2013), for review).

Previous work demonstrates the psychometric soundness of the IFM variable, which is the average amplitude to a repeated unfamiliar face minus the average amplitude to single (i.e., unique) unfamiliar faces at the parietal midline electrode cluster at 300–500 ms poststimulus. Repetition of a socially salient stimulus (previously unfamiliar face) among nonrepeated unfamiliar faces elicits increased parietal positivity within 300–500 ms in TD participants, but not in participants with diagnoses rooted in social cognition impairment (autism, Williams syndrome, Prader-Willi syndrome; Key & Dykens, 2016); furthermore, such response is not observed for the repeated versus single presentation of unfamiliar nonsocial stimuli, that is, houses; (Key & Corbett, 2014; Key & Dykens, 2017). It was also demonstrated that the parietal IFM response in ASD is stable over time in the absence of an intervention but increases following the EXP condition (Corbett et al., 2019; Key

& Corbett, 2014). Therefore, it has been interpreted that larger parietal response to repeated faces than to unique faces indicates greater face memory (Key & Corbett, 2014). The IFM variable is the primary DV in the present study.

Electroencephalography was acquired using 32–128-channel arrays (Biosemi, BrainVision ActiCap or Electrical Geodesics, Inc. hydrocel sensor net, depending on the equipment available at each study site). Prior to study initiation, the same adult human phantom completed the IFM data acquisition at all locations (see (Saby et al., 2021), for a similar approach). The phantom data revealed similar ERP waveform morphology at all sites. For analysis, data from all sites were sampled at 250 Hz with the filters set to .1–30 Hz, segmented on stimulus onset to include a 100-ms prestimulus baseline and a 900 ms poststimulus interval, and re-referenced offline to an average reference (Picton et al., 2000). Data for electrodes with poor signal quality were reconstructed using spherical spline interpolation procedures. A minimum of 10 artifact-free trials was required for each condition to be included in the analysis. Importantly, the specific scalp locations and time interval indexing IFM and were selected a priori based on results in previous studies using this paradigm (Corbett et al., 2016; Key & Corbett, 2014; Key & Dykens, 2016).

## Secondary Outcome Measures

### *Contextual Assessment of Social Skills (Ratto et al., 2011)*

The Contextual Assessment of Social Skills (CASS) is an ecologically valid social interaction protocol developed to ascertain several domains of social functioning in youth and young adults with ASD. Participants engage in two sequential 3-min role-play scenarios with two trained unfamiliar, opposite-sex TD peers who gave the appearance of being in middle-to-high school (actual ages 9–22 years). The participants and confederates were instructed to “get to know one another” without specific instructions on topics of discussion. Each scenario was videotaped and domains of behavior were coded by reliable coders ( $\geq 80\%$  on training videos [Ratto et al., 2011]) based on a 7-point Likert scale (e.g., “1” reflects low/impaired performance to “7” reflects a high/skilled behavior). The CASS features two conditions, *Interested* (CASS-I) and *Bored* (CASS-B). Only the CASS-I was used in the analysis because past studies show the CASS-I condition yielded variables sensitive to treatment effects (Dolan et al., 2016; Rabin et al., 2018; White et al., 2015). Although all behavior domains were coded, a subset of domains was selected based on research showing significant treatment effects following a social skills program (Dolan et al., 2016; Idris et al., 2022) and content validity on a previous RCT for the EXP condition (Corbett et al., 2017).

The DVs analyzed from the CASS included raw scores from the following: *Vocal Expressiveness* (degree to which the participant varies the tempo, pitch, tone, volume, and/or rhythm of speech), *Quality of Rapport* (degree of rapport and reciprocity between the participant and confederate), and *Social Anxiety* (verbal and non-verbal markers of anxiety). At each site, 10% of videos were double-coded by reviewers blind to treatment group assignment to maintain coding calibration, and 20% of videos across all sites were assessed by a master coder to assess for coder drift. Intraclass correlations for the three domains, ICC (2,2) Vocal Expressiveness .89; Quality of

Rapport .84; and Social Anxiety .74 (Shrout & Fleiss, 1979), reflected good to moderate cross-site agreement.

### ***Social Responsiveness Scale, Second Edition (Constantino and Gruber, 2012)***

The Social Responsiveness Scale, Second Edition (SRS-2) is a parent-report measure of behavioral characteristic of autism. Internal consistency ranges from .77 to .90 and test-retest ranges from .77 to .88. The SRS-2 has been used as a functional outcome measure in treatment studies in ASD (Hardan et al., 2012; Hendren et al., 2016; LaGasse, 2014; Laugeson & Park, 2014; Yui et al., 2012). The Standard Scores on the SRS-2 Communication Domain was selected because previous research showed treatment effects (Corbett et al., 2016) and large, positive effect sizes in other treatment studies ((Wolstencroft et al., 2018) for review).

### **Statistical Analysis**

#### ***Power Analysis***

We conducted a priori power analyses for all hypotheses using a simulation procedure described (Muthén & Muthén, 2002) by Muthén and Muthén (2002) and implemented in Mplus 8.4 (Muthén & Muthén, 1998–2020). Population models were specified using parameter values derived from past research in tandem with minimal expected effect sizes for the effects of most interest. These models were used to generate 5,000 samples for a given  $N$ , the models were fit to each sample, and the significance (or not) of key effects was noted. The proportion of trials in which a key parameter estimate was flagged as significant can be taken as an estimate of empirical power. This process was repeated for different values of  $N$  until the target power of at least .80 was reached indicating with 216 participants we would have .82 power.

#### ***Primary Hypothesis Tests***

We used structural equation modeling, as implemented in Mplus 8.7, as a framework for testing all primary hypotheses. We accounted for any nonindependence of observations due to cohort membership by obtaining cluster-robust standard errors using robust maximum likelihood estimation (MLR in Mplus) in tandem with the TYPE = COMPLEX option available in Mplus, treating cohorts as clusters. All models were structurally saturated, so model fit was necessarily perfect.

Because the COVID-19 pandemic resulted in variation in lag, or the interval between administrations of some of the measures, we controlled for lag in our statistical models in an effort to rule out this potential confound. Additionally, pretests were statistically controlled. Unless otherwise noted, we used one-sided hypothesis tests because there was a clear expectation for the direction of an effect favoring the SENSE Theatre group.

The data for this study have been submitted to the National Database for Autism Research (NDAR) via the following URL at [https://nda.nih.gov/edit\\_collection.html?id=2866](https://nda.nih.gov/edit_collection.html?id=2866). The NDAR repository sets standard criteria for accessing data. The study protocol is available upon request to the first author.

### **Results**

#### **Fidelity Results**

Delivery fidelity was conducted by research-reliable trainers examining the extent to which peers implemented the program as intended. This was done in vivo, during odd-numbered sessions for both conditions. Fidelity could range from 0 (no objectives met) to 100 (complete fidelity). There was no significant difference across sites therefore data were pooled. For the EXP group Day 1, 3, 5, and 7, the mean ratings for the quality of peer implementation of behavioral techniques were as follows: 89.92 (15.06), 91.52 (12.36), 95.07 (7.63), and 95.56 (6.94), respectively. For the EXP group, Core Objectives were as follows: 89.88 (13.66), 90.95 (12.41), 94.59 (8.02), and 96.78 (4.53), respectively, suggesting that fidelity was solid and improved over time. For the ACC Overall Content, Day 1, 3, 5, and 7, the mean ratings for the manualized implementation were 99.71 (1.21), 99.29 (2.02), 98.67 (2.29), and 100 (0.0). For the clinician implementation delivery, the ratings were as follows: 98.62 (1.72), 99.80 (0.82), 99.56 (1.17), and 100 (0.0), suggesting strong and consistent fidelity over time.

#### **Primary Results**

Table 2 provides the unadjusted means and  $SD$ s for all three periods by group for all 5 DVs. Unadjusted means and  $SD$ s are provided for future meta-analyses.

*Hypothesis 1:* Youth in the EXP group will demonstrate significantly greater posttest Incidental Face Memory than in the ACC group. A significant group difference was found when using a one-sided hypothesis test (unstandardized  $b = .874$ ,  $p = .039$ ; Cohen's  $d = 3.63$ ) with larger IFM responses in the SENSE Theatre than the TTT group (see Figure 2). Neither lag (unstandardized  $b = .018$ ,  $p = .211$ , two-sided; Cohen's  $d = .007$ ) nor pretest IFM (unstandardized  $b = .036$ ,  $p = .276$ ; Cohen's  $d = .015$ ) significantly predicted posttest values.

*Hypothesis 2.1a:* Youth in the EXP group will demonstrate significantly better posttest social behavior than youth in the ACC group (i.e., Quality of Rapport, Vocal Expressiveness, and Social Anxiety). No immediate treatment effects were detected on posttest social behavior variables. No significant group difference was found in posttest Vocal Expressiveness when using a one-sided hypothesis test (unstandardized  $b = .466$ ,  $p = .217$ ; Cohen's  $d = .281$ ). No significant group difference in posttest Quality of Rapport was found when using a one-sided hypothesis test (unstandardized  $b = -.044$ ,  $p = .448$ ; Cohen's  $d = -.029$ ). No significant group difference in posttest Social Anxiety was found when using a one-sided hypothesis test (unstandardized  $b = .349$ ,  $p = .150$ ; Cohen's  $d = .226$ ).

*Hypothesis 2.1b:* Youth in the EXP group will demonstrate significantly better posttest social functioning than youth in the ACC group. The unmediated treatment effect on the social functioning variable was nonsignificant. That is, no significant group difference was found in posttest SRS-2 Communication (unstandardized  $b = .016$ ,  $p = .490$ ; Cohen's  $d = .002$ ).

*Hypothesis 2.2a:* Posttest Incidental Face Memory (ERP) will mediate the treatment effect on follow-up social behavior.



**Table 2**  
*Primary and Secondary Dependent Variables at Pretest, Posttest, and Follow-Up*

Variable	SENSE			TTT		
	Pre	Post <i>M (SD)</i>	FLWP	Pre	Post <i>M (SD)</i>	FLWP
IFM index	-.31 (3.99)	.74 (2.39)	.12 (3.05)	-.17 (3.27)	-.22 (2.37)	.01 (3.27)
CASS						
Vocal expressiveness	4.30 (1.70)	4.29 (1.59)	4.20 (1.53)	4.32 (1.56)	3.94 (1.76)	4.05 (1.75)
Quality of rapport	4.16 (1.39)	4.14 (1.39)	4.26 (1.29)	4.10 (1.21)	4.23 (1.66)	4.22 (1.49)
Social anxiety	3.61 (1.61)	4.19 (1.53)	3.90 (1.40)	3.99 (1.45)	4.03 (1.59)	3.77 (1.58)
SRS-2 communication	32.33 (8.98)	30.33 (9.32)	29.74 (9.23)	32.28 (9.58)	30.22 (9.43)	29.82 (9.86)

*Note.* SENSE = SENSE Theatre; TTT = Tackling Teenage Training; FLWP = Follow-up; IFM = Incidental Face Memory (Average parietal ERP amplitude difference between Repeated and Single Faces); CASS = Contextual Assessment of Social Skills; SRS-2 = Social Responsiveness Scale; ERP = event-related potential.

In these three analyses, we adjusted standard errors for cohort, controlled the mediator for individual differences in lag between pretest and posttest for the *a* path and controlled the outcome for individual differences in lag between pretest to follow-up for the *b* and *c'* paths. The residuals associated with the mediator and outcome were allowed to covary with the lag and pretest scores associated with the outcome, and the residual associated with the outcome was allowed to covary with the lag and pretest scores associated with the mediator, yielding a saturated model. Confidence intervals (CIs) for indirect effects were obtained by using a Monte Carlo simulation-based method with 10,000,000 draws (Preacher & Selig, 2012).

The indirect effect of SENSE Theatre versus TTT through posttest IFM on follow-up Vocal Expressiveness and Quality of Rapport was significant; however, the indirect effect on follow-up Social Anxiety was not significant. Specifically, the partially standardized indirect effect<sup>3</sup> (MacKinnon, 2008; Preacher & Kelley, 2011) of SENSE Theatre versus TTT through posttest IFM on follow-up Vocal Expressiveness was  $a \times b = .064$ , with 90% CI [.014, .118], implying a significant one-sided hypothesis test at  $\alpha = .05$  (see Figure 3). Similarly, the partially standardized indirect effect of SENSE Theatre versus TTT through posttest IFM on follow-up Quality of Rapport was  $a \times b = .032$ , with 90% CI [.002, .087], implying a significant one-sided hypothesis test at  $\alpha = .05$  (see Figure 4). In contrast, the partially standardized indirect effect of treatment on follow-up Social Anxiety through posttest IFM was  $a \times b = .005$ , with 90% CI [-0.015, .059], implying a nonsignificant one-sided hypothesis test at  $\alpha = .05$ . The total treatment effect on all three social behavior variables was nonsignificant ( $p > .05$ ).

**Hypothesis 2.2b:** Posttest Incidental Face Memory (ERP) will mediate the treatment effect on follow-up social functioning. The partially standardized indirect effect of treatment on follow-up SRS-2 Communication was  $a \times b = -.0002$ , with 90% CI [-0.054, .061], implying a nonsignificant one-sided hypothesis test at  $\alpha = .05$ . The total treatment effect on the social functioning variable was nonsignificant ( $p > .05$ ).

To examine the extent to which changes occurred within the treatment groups, within-condition analyses were conducted to determine change from pre to post and pre to follow-up across

each of the four outcomes (See Supplemental Table A). The results show significant differences in the SENSE Theatre on SRS-2 Communication from pre-post and prefollow-up suggesting improvement. For TTT, there was a significant difference also on SRS-2 Communication from pre-post.

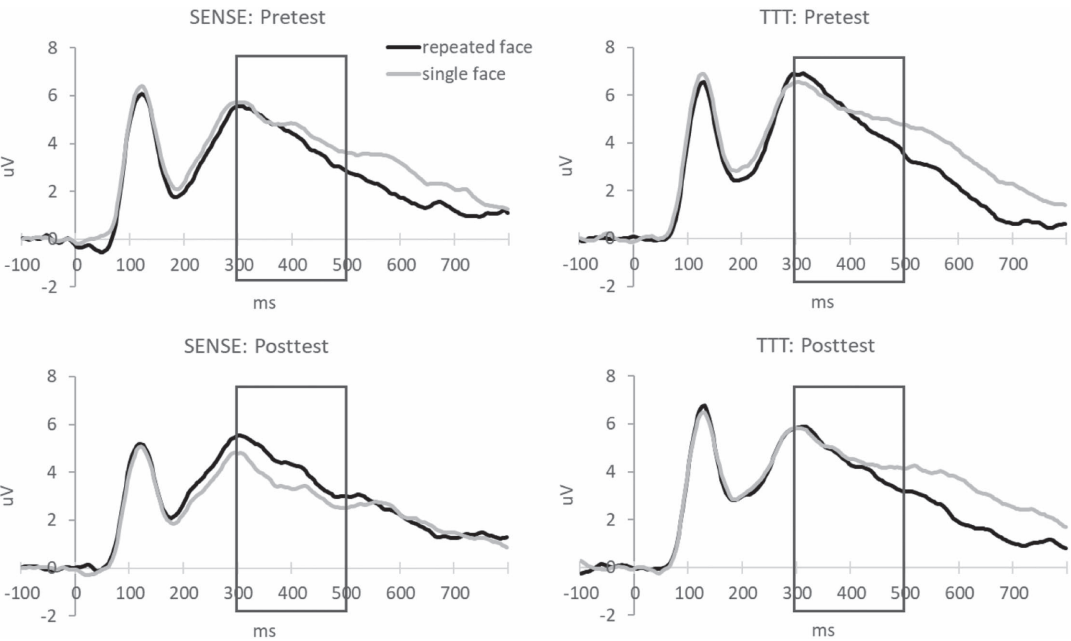
To quantify clinical significance, we used a reliable change index (RCI; Jacobson & Truax, 1991), which is a per-subject change from baseline. The RCI is computed in the pre- to postscenario as (post-pre)/SEdiff for each subject. Reliable change is demonstrated if that subject's RCI exceeds  $\pm 1.96$ . The results of the RCI analysis are presented in Supplemental Table B. The results show that for pre-post and prefollow-up across the 4 outcomes, the SENSE Theatre treatment showed a higher percentage of clinically meaningful change compared to TTT. The one exception was Quality of Rapport for pre-post, in which TTT showed slightly higher percentage of participants showing change.

## Discussion

Most social interventions to date have relied on didactic skills-based instruction rather than being tethered to a mechanism empirically linked in these fundamental social cognition deficits. The approach for the RCT was built on a social competence framework comprised of neural, cognitive, behavioral, and functional components to guide the understanding, measurement, and treatment of ASD. The primary hypothesis that youth in the EXP group (SENSE Theatre) would demonstrate significantly greater posttest IFM than the ACC group (TTT) was supported, suggesting increased salience of social stimuli. Without considering the mediating influence of IFM, there was no evidence that youth in the EXP group had better social behavior (i.e., Vocal Expressiveness, Rapport, Social Anxiety), or functioning (Social Communication) at posttest than youth in the ACC group. However, when posttest Incidental Face Memory (ERP) was modeled as the mediator, there was a significant treatment effect on follow-up social behavior; specifically, Vocal Expressiveness, and Rapport. Importantly, statistically significant indirect effects can be interpreted even when total effects are nonsignificant (Hayes, 2022).

<sup>3</sup> Similar to MacKinnon (2008) and Preacher and Kelley (2011), we multiplied the standardized mean difference in the mediator across treatment conditions (Cohen's *d*) by the standardized slope linking the mediator to the outcome.

**Figure 2**  
*Event-Related Potential Waveforms in Response to Repeated and Single Faces at the Parietal Cluster for the Experimental (SENSE Theatre) and Active Control Condition (Tackling Teenage Training) Groups at Pretest and Posttest*



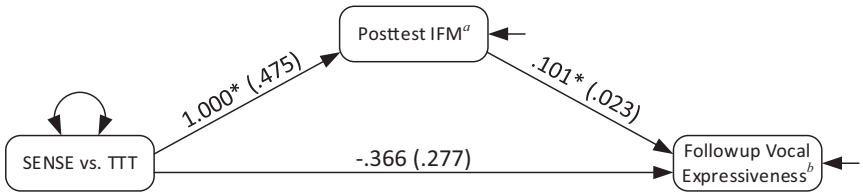
*Note.* Rectangular marker identifies the time window used in the analysis. SENSE = SENSE Theatre; TTT = Tackling Teenage Training.

In humans, face memory is important for orienting one’s automatic attention to relevant social information; thereby, increased social salience has the potential to improve social cognition and ultimately change behavior. Impairment in face memory is frequently found in ASD (Key & Corbett, 2014; Langdell, 1978; Osterling et al., 2002; S. J. Webb et al., 2010; Weigelt et al., 2012) and intricately connected to high-level demands of social behavior; as such, it may serve as a primary target of engagement in social skills interventions (Corbett, Newsom, et al., 2014). The increase in social salience of faces reflected in the greater ERP amplitude indexing memory for the

repeated image in the current and previous studies of SENSE Theatre (Corbett et al., 2016, 2019; Ioannou et al., 2020) suggests that the treatment is contributing to greater motivational value placed on social stimuli.

Methodical behavioral observation of social behavior in ASD during interactions similar to those experienced in the real world is one of the most ecologically valid ways to measure social skills (Corbett et al., 2016; Dolan et al., 2016; Laugeson et al., 2009; White et al., 2015), but seldom occurs in social skills RCTs (Elliott & Gresham, 1987; Lord & McGill-Evans, 1995; McMahon et al., 2013).

**Figure 3**  
*Path Diagram of SENSE Theatre’s Comparative Indirect Effect on Vocal Expressiveness at Follow-Up Through Incidental Face Memory (IFM) at Posttest*

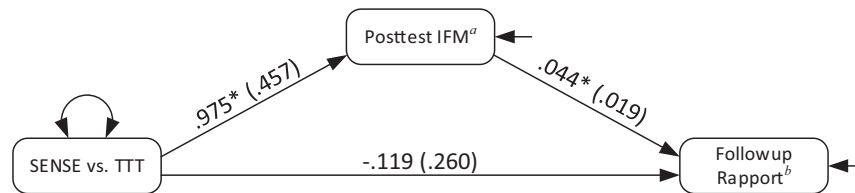


*Note.* Unstandardized coefficients (and standard errors) are shown. The partially standardized indirect effect ( $a \times b$ ) = .064, 90% CI [.014, .118]. SENSE = SENSE Theatre; TTT = Tackling Teenage Training; CI = confidence interval.

<sup>a</sup> Controlling for IFM at pretest and the interval between pretest and posttest. <sup>b</sup> Controlling for Vocal Expressiveness at pretest and the interval between pretest and follow-up assessments.  
\*  $p < .05$ , one-tailed.

**Figure 4**

*Path Diagram of SENSE Theatre's Comparative Indirect Effect on Rapport at Follow-Up Through Incidental Face Memory (IFM) at Posttest*



*Note.* Unstandardized coefficients (and standard errors) are shown. The partially standardized indirect effect ( $a \times b$ ) = .032, 90% CI [.002, .087]. SENSE = SENSE Theatre; TTT = Tackling Teenage Training; CI = confidence interval.

<sup>a</sup>Controlling for IFM at pretest and the interval between pretest and posttest. <sup>b</sup>Controlling for Rapport at pretest and the interval between pretest and follow-up assessments.

\*  $p < .05$ , one-tailed.

Furthermore, observing social interaction with typically developing peers not affiliated with the treatment and conducted in nontreatment settings allows the ability to examine the transfer of skills and generalization across contexts, respectively. The use of the CASS with examiners and coders naïve to treatment assignment provided a way to objectively look at the effect of treatment on the transfer of social behavior (Ratto et al., 2011).

It has been shown that IFM strongly predicts social interaction patterns in TD children and autistic children, such that better face memory is associated with more cooperative play with peers (Corbett, Newsom, et al., 2014). Relative to TTT, SENSE Theatre has an indirect effect on social behavior through enhancement of IFM, suggesting increased importance of broader social stimuli (e.g., people) over time. In other words, the underlying mechanism enhances social salience, which facilitates attention to and engagement with others to improve reciprocal verbal communication and rapport-building skills with practice.

While there were no significant direct effects on social behavior at the posttest or follow-up, it is highly plausible that a developmental lag exists between skill acquisition (enhanced social awareness) to application (greater social reciprocity with others). In other words, it takes time for these complex skills to emerge and be applied in daily life. Notably, the CASS protocol utilizes novel peers in a naturalistic social interaction thereby serving as a robust measure of skill transfer of key facets of social reciprocity. As with many facets of learning and development, there is often a period in which learned behavior is practiced and becomes integrated before manifesting in behavior that is observable and automatic.

It is important to note that previous studies of SENSE Theatre showed strong effect size at posttest for IFM ( $d = .93$ , [Corbett et al., 2016]) when compared to a waitlist control group (WLC), which led to the predicted and supported IFM mediation effect. Consistent with research indicating that when an intervention is compared to another active treatment with demonstrated efficacy, the effect sizes will be much smaller (Gates et al., 2017), the effect sizes in the present study using an ACC rather than a WLC appear reasonable. Small effect is not the same as no effect; thereby, findings do not refute the hypothesized advantages of SENSE Theatre as a performance- versus knowledge-based intervention. The peers, play, and performance components likely facilitate the development of necessary social

engagement skills such as verbal expression and building rapport with peers.

Direct comparison to another established social intervention for youth with ASD embraces the rigor and transparency of science. The fact that both interventions show change from baseline suggests that both interventions have merit. Future research is needed to reveal what types of treatment may be optimal for a given child's profile. Specifically, future research should examine moderating factors (e.g., demographic, co-occurring conditions) that may contribute to better clinical outcomes. Moreover, studies are needed that inform best practices as to when to use knowledge-based versus performance-based approaches.

Although the specific components of SENSE Theatre that lead to the observed treatment effect are unknown, it is speculated that peers, play, and performance contribute in key ways. Peer-mediated approaches have been shown to enhance social skills and help generalize skills to other social contexts via programmed practice (DiSalvo & Oswald, 2002; Rao et al., 2008). It is plausible that the inclusion of trained and supportive peers facilitates interaction thus building rapport and reciprocity. The inclusion of the theater techniques, play with peers, and creating a character in a play enhances drive to interact with others both on and off the stage. Finally, in contrast to many knowledge-based social skills interventions, SENSE Theatre is fundamentally performance-based, allowing repeated practice of newly learned social skills such as vocal expressiveness. The increase in generalized and persistent social salience demonstrated by interaction with novel peers supports the notion of a desire to reproduce social success experienced during the theater activities. At this point, it is unclear if it is an automatic process or deliberate act, yet the complexity of the social response suggests at least some conscious, volitional intent to engage with others in a manner similar to positive interactions during the treatment.

The aforementioned ERP results indicate that a neural mechanism supporting social cognition and driven by social salience is engaged by the SENSE Theatre treatment and has a generalized, indirect effect on clinically meaningful functional outcomes related to core symptoms of autism.

If replicated, the indirect treatment effects on quality of rapport and vocal expressiveness through IFM are noteworthy even though the effects are small. First, the effect size estimate is very likely to be

quite conservative because we are comparing two active treatments. The ACC was structurally equivalent to the EXP condition in terms of dose and structure (Baskin et al., 2003). Thus, the effect size represents the size of the SENSE Theatre effect above and beyond that which might have occurred from TTT. Second, quality of rapport, vocal expressiveness, and IFM are measures of distal and highly generalized characteristics. They are not directly targeted goals of SENSE Theatre. Thus, effects on them are due to upstream effects on more proximal targets. Additionally, the procedure used to measure these three outcomes is not context-dependent as they differ from SENSE Theatre on multiple dimensions (e.g., person, place, materials, activities). Distal and generalized characteristics are particularly important because they represent abilities that tend to be more consolidated than proximal and context-dependent outcomes (Yoder et al., 2013). Replicated evidence shows that treatments have weaker effects on generalized and distal outcomes (Sandbank et al., 2020); thus, the benchmarks for interpreting their effect sizes need to be smaller than those for proximal and context-dependent outcomes. Third, quality of rapport and vocal expressiveness were measured approximately 2 months after treatment ended. Treatment effects on follow-up outcomes tend to be smaller than on outcomes at immediate posttreatment periods when the treatment is implemented by professionals or research staff due to the well-documented phenomenon of reduced maintenance (Gunning et al., 2019). Demonstration of treatment effects on follow-up outcomes is relatively unusual in the autism treatment literature (Gunning et al., 2019). Fourth, it is extremely atypical to document that a neural measure of a mechanism mediates behavioral treatment effects on functional outcomes in the autism treatment field. Finally, the measurement approaches used to assess IFM, quality of rapport, and vocal expressiveness do not allow detection bias to explain the between-group differences. It is quite rare for randomized control efficacy tests in children with ASD to find treatment effects on such variables (Sandbank et al., 2020).

### Strengths, Limitations, and Future Directions

The RCT had a number of strengths (e.g., multisite design, multimodal objective measures, several cohorts) and several quality indicators for clinical trials (Smith et al., 2007) including random assignment, manuals, clear rationale for choice of outcome measures, masking of group assignment for coders/evaluators, appropriate statistical design that improved upon previous studies of the intervention (e.g., [Corbett et al., 2016]). Nevertheless, there are limitations to acknowledge. Perhaps most notably is the data loss due to the COVID-19 pandemic, which resulted in reduction in the number of participants who completed the study, data loss of specific primary variables, and differential attrition between the groups. All cohort treatments were received in-person, with the majority of participants (78.26%) engaged in the treatment as intended without masks. As shown in the Consolidated Standards of Reporting Trials diagram (see Figure 1), data from participants impacted by the pandemic that could not attend 7 or more of the sessions were not included in the analyses.

In addition to the COVID-19 pandemic, there was differential attrition between TTT and SENSE Theatre. It is likely that the TTT intervention is less engaging than SENSE Theatre. By design, SENSE Theatre aims to create a supportive 1:1 model which incentivizes participants to stay committed to their peer.

Additionally, the theater-based program facilitates working toward a common goal which may be meaningful to participants. Finally, the setting and approach of SENSE Theatre supports group cohesion, which is a well-established construct reducing attrition (Lerner et al., 2013). Importantly, the observed treatment effects of SENSE Theatre are likely underestimated, because we were able to analyze only those participants who were sufficiently engaged to stay in the study in both conditions. Most of those who dropped out (presumably due to lower engagement in TTT) were clearly less likely to benefit from their treatment and had they been retained and assessed, it is very likely that the treatment effect would be larger. That is, if there is indeed bias in the treatment effect due to missingness, it is likely to make the between-condition effect look weaker than it really is. Collectively, the significant attrition group differences with TTT suggests a measurable benefit of SENSE Theatre.

Additionally, the sample did not include individuals with intellectual disability (ID), and a large percentage of the sample was White; therefore, it was not fully representative of the broader autism spectrum or National race/ethnicity averages. Despite the high co-occurrence of attention-deficit hyperactivity disorder in ASD (Mutluer et al., 2022) and overlap between executive dysfunction and face identity (e.g., [Griffin et al., 2021]), measurement of these constructs was not conducted in the study. Future studies are needed to address these limitations such as the inclusion of individuals with ASD and ID and enhanced characterization of the sample.

### Conclusions

In summary, SENSE Theatre via peer mediation and theater techniques targets and boosts salience of social stimuli that over time increases spontaneous social behavior. Exposure to trained, supportive peers, and acting exercises increases social attention and further enhances motivation to engage with others via repeat exposure. As a result of increased social interest, there is greater attention to vital social information (e.g., faces) and thereby increased performance of key social behaviors including vocal expression and reciprocal social engagement with others.

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## Appendix

### Narrative Description of Associated Publications

Four articles have been published using *only baseline (pretest) data* from this study. Corbett et al. (2021) explores sex-based differences in autistic camouflaging using Autism Diagnostic Observation Schedule–Second Edition (ADOS-2), Contextual Assessment of Social Skills (CASS), and Theory of Mind variables. Simmons et al. (2021) focuses primarily on the CASS and its associated Conversation Rating Scale and Social Responsiveness Scale (SRS-2), ADOS-2, and NEPSY variables. In Key, Yan, et al. (2022), hyperscanning electroencephalography is used to study neural synchrony between individuals with autism spectrum disorder and typical development. The most recent publication (Key, Jones, et al., 2022) reports

findings related to automatic facial emotion processing on a separate event-related potential tasks. Neither; event-related potential (ERP) papers report on Incidental Face Memory (IFM), which serves as the primary DV in the current RCT. The current article is the first to report treatment effects using the CASS and IFM data.

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