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Title: Improving Social Interaction for Adolescents with Autism During the Transition to Adulthood

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Methodology

Participants

In total, we are aiming for 154 participants ages 18 to 21 to be tested interacting in pairs of one autistic and one non-autistic participant. Participants are assigned to one of three conditions:

1. The "neurostimulation" group with 22 autistic and 44 non-autistic adolescents. The autistic participants complete two sessions with different non-autistic participants at least one week apart, once with active neurostimulation preceding the social interaction, and once with sham neurostimulation in order to rule out placebo effects. This group allows for evaluation of Goal 2.

2. The "inclusion training" group with 22 autistic and 22 TD adolescents. Each non-autistic participant receives inclusion training prior to the interaction. Comparing outcomes with the "no intervention" group allows for evaluation of Goal 3.

3. The "no intervention" group consists of 22 autistic and 22 non-autistic adolescents. This group allows for evaluation of Goal 1 and also serves as a baseline for comparison with the intervention groups.

All participants will be male and between 18 and 21 years old. There is a disproportionate male to female ratio in autism of 4:1 (Fombonne, 2009), and the recruitment source used for this study is over 80% male. Thus, we would not have enough female participants to assess gender effects and because social interaction likely differs between mixed-sex interactions relative to same-sex ones, including a handful of females would confound reported findings. All included autistic participants will have a composite score above the clinical threshold for ASD on the Autism Diagnostic Observation Schedule (ADOS-II; Lord et al., 2012). Non-autistic participants will have no history of psychiatric illness or developmental disabilities and no current ASD diagnosis or a first degree relative with an ASD diagnosis. Interaction partners within and across the three groups will be matched on age and race, and comparable on IQ. To control for effects of intellectual ability, and to ensure results are most relevant to autistic older adolescents without intellectual disability, all participants will have measured full-scale IQs over 80 to ensure they are in the average to above average range.

Autistic participants will be recruited from the Autism Research Collaborative at UT Dallas, a database established by Dr. Sasson of over 150 local autistic adolescents and young adults who have consented to participate in research studies at UTD. Individuals in this database have been clinically evaluated previously and satisfy the eligibility requirements for participation in this study. Non-autistic adults will primarily be students at UT Dallas participating to receive course credit, as well as a database of students who have consented to be contacted to participate in paid research. Data collection will occur in Dr. Sasson's laboratory at UT Dallas, or at the nonPareil Institute, a non-profit organization for autistic adults in Plano, Texas that has partnered with Dr. Sasson for research studies and provides his lab group with space for testing.

Procedures

Participants are screened prior to data collection to rule out exclusion criteria, answer demographic questions, determine scheduling availability, and ensure unfamiliarity with their potential interaction partner. Testing rooms will have two chairs positioned opposite each other for the social interaction, and a video camera will be set up to capture both participants' full bodies in the frame. Chairs will be angled in such a way that faces are clearly visible to the video camera. After the informed consent process, participants will complete a videotaped unstructured measure of dyadic interaction, first developed for interactions between non-autistic individuals (Berry & Hansen, 1996) but recently used in autism (Usher et al., 2018). Participants will be seated opposite from each other in front of a video camera and instructed that they will have five minutes to get to know each other. The research assistant then will turn on the camera and set a timer for five minutes. Although the researcher will be present during the conversation to ensure participants complete the interaction, he or she will be separated from the participants using a partition.

Measures

Following the interaction, participants will complete measures at separate computer stations partitioned from each other using Qualtrics Survey software. These measures include:

1. *The Social Interaction Evaluation Measure* (Berry & Hansen, 1996): assesses each partners' evaluation of interaction quality (e.g., enjoyment of the interaction), disclosure (e.g., how much did your partner disclose in the conversation), engagement (e.g., how much did your partner influence the conversation), and intimacy (e.g., to what extent was the interaction intimate).
2. *First Impression Scale* (Sasson et al., 2017): participants rate their partner on different traits (e.g., likeability and intelligence) and their intent to engage in future interactions.
3. *The Subjective Closeness Index* (Berscheid et al., 1989) and *the Inclusion of the Other in the Self* (Aron et al., 1997): participants rate feelings of "closeness" to their partner, which is predictive of friendship formation of two unfamiliar partners and can be reliably detected even in brief interactions (Aron et al., 1997).

For items 1 and 2 above, participants will also report how they expect they will be rated on these items by their partner. We have shown that young autistic adults are often less accurate at determining how they are viewed by others (Sasson et al., 2018), an important skill for managing social relationships. We predict here that older autistic adolescents will not only be rated more poorly by their non-autistic partner than vice versa, but that they also will be poor at detecting they are being evaluated in this way. The neurostimulation intervention that targets areas of the brain involved in perspective-taking is predicted to improve this ability in our autistic participants. In contrast, the inclusion training is predicted to improve non-autistic impressions of autistic participants, but not affect autistic behavior or responses.

Participants also complete measures assessing their social cognitive and social motivation abilities, as these affect social behavior and often differ in autism:

1. *Penn Emotion Recognition Task* (Kohler et al., 2000): assesses the ability to recognize five basic emotions (i.e., happiness, sadness, fear, anger, and no emotion) from facial expressions.
2. *Benton Facial Recognition Task* (Benton et al., 1983): measures the ability to process facial identity.

3. *The Awareness of Social Inference Task* (TASIT; MacDonald et al., 2003): participants will view 16 videotaped vignettes of social interactions involving white lies or sarcasm and are asked to answer questions about what the characters' intentions and motivations.
4. *Friendship Motivation Scale* (Richard & Schneider. 2005): a 12-item questionnaire that assesses the participant's desire to seek out and form social relationships.

Analytic Plan

Sample sizes were selected in consultation with Statistician Dr. Robert Ackerman to ensure successful detection of the anticipated medium effect sizes with 80% power. The research team consists of established researchers who are well experienced in data analysis and interpretation. For this project, we have selected an analytic approach designed to evaluate our three primary research goals. First, all self-report questionnaires will be evaluated for internal consistency using Cronbach's alpha, and the Conversation Probe social behaviors will be evaluated with Intraclass Correlation Coefficients (ICC) for agreement between coders. In addition to reliability, descriptive statistics will be run for all measures, examining group means, standard deviations, and normality of all measures.

Next, all primary goals will be assessed using an "Actor Partner Interdependence Model" (APIM; Kenny, Kashy, and Cook, 2006). Because data will be collected on two interacting individuals, the primary outcomes for both partners will be related (i.e., interaction evaluations, closeness, and impressions are dependent on the interaction with the partner). Thus, outcomes will be non-independent, and traditional analytic techniques using the general linear model cannot be used. Additionally, hypotheses examining how the partners influence each other cannot be examined with these traditional techniques and instead must be modeled with analyses like the APIM that take non-independence into account. APIM can estimate three types of effects. First, APIM can specify actor effects, or the effect of the individual's own behavior (e.g., overall social skills or social cognitive ability) on the individual's own outcome (e.g., interaction quality). Second, these models can specify partner effects, or the effect of the partner's behaviors or abilities on the individual's outcome. Finally, this model can specify interaction effects, allowing for examination of how an individual's behaviors and traits are related to his own outcomes depending on his partner's behaviors and traits.

To examine effects of autism acceptance training on non-autistic participants interaction with autistic partners, zero-order correlations between participants' interaction ratings were evaluated to assess the relationship between indicators, as well as the consistency of ratings between partners. Two factor mixed-model ANOVAs were run using a Geisser-Greenhouse correction to assess the effects of diagnosis (autistic vs. non-autistic) and training condition (Autism Acceptance Training vs. control) on how participants evaluated their conversation partner and the overall interaction. Specifically, training condition was treated as a between-subjects variable and autistic and NA interaction ratings (interaction quality, first impressions, closeness, warmth and dominance) were treated as a within-subjects factor, with separate analyses run for each outcome measure. As IQ differed significantly between autistic and NA individuals within dyads, WRAT-3 scores were included as a covariate in each ANOVA. All analyses were completed using SPSS 27 (IBM SPSS Inc., 2015).

All analyses addressing each of the three goals will be conducted separately for each social interaction outcome: social interaction evaluation, closeness, and first impressions formed (i.e., traits and behavioral intentions). Analyses for goal 3 (the "no intervention" condition) will serve as a baseline to compare effectiveness of the neurostimulation intervention (goal 1) and the inclusion training (goal 2). Compared to baseline, it is anticipated that neurostimulation of autistic participants will lead to increased evaluation of their social skill, better performance on social cognitive tasks, and higher ratings by their non-autistic partners on closeness and first impressions. Both partners in the neurostimulation condition are predicted to rate the quality of the social interaction higher than in the baseline condition. Goal 2 (inclusion training for the non-autistic participant) is predicted to lead to higher ratings of closeness and first impressions made by non-autistic participants of their autistic partners, with both partners evaluating the social interaction more positively compared to the "no intervention" condition. Because inclusion training only targets the non-autistic individual, social skill and social cognitive performance of autistic participants is not expected to differ here compared to baseline. Finally, we will be able to compare effects between Goal 1 and Goal 2 to determine which intervention, neurostimulation or inclusion training, produces better social outcomes for autistic adolescents. Due to the number of tests that will be performed, all significance tests will be evaluated at an adjusted alpha threshold of .01.