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Camouflaging in Autism: Examining Sex-Based and Compensatory Models in Social Cognition and Communication

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Abstract

Camouflaging refers to behavioral adaptations that individuals with autism spectrum disorder (ASD), especially females, use to mask symptoms during social situations. Compensation is a component of camouflaging in which an individual's observed behavior is considerably better than actual ability. The study explored diagnostic, sex-based and compensatory differences using the Contextual Assessment of Social Skills (CASS). The sample included 161 youth 10:0-to-16:11 years (115 males, 46 females). T-tests were performed based on sex (female, male) or High (good ADOS+Poor Theory of Mind (TOM)) compared to Low (poor ADOS+poor TOM) Compensation groups. Comparisons were examined for Social Affect (SA), Restricted Repetitive Behavior, (RRB), IQ, social behavior (Positive Affect, Overall Involvement) and communication (Vocal Expression, Gestures). Females exhibited fewer RRB $t(158)=3.05$, $p=0.003$, $d=0.54$. For the CASS, females evidenced more Vocal Expressiveness $t(157)=-2.03$, $p=0.05$, $d=0.35$, which corroborates sex-based differences in the literature. Compensation group differences indicated the High compared to Low group showed stronger Social and Communication behaviors on the CASS for Vocal Expression $t(72)=2.56$, $p=0.01$, d=0.62, and overall rapport $t(72)=2.36$, $p=0.02$, $d=0.56$. Several differences were observed when the groups were stratified based on level of compensation, with the High compensation participants showing stronger social engagement and communication behaviors. Findings may inform efforts to understand camouflaging, compensation, and clinical practices for male and female adolescents with ASD. A more nuanced consideration of camouflaging alongside compensation models reveals subtle differences in cognition, behavior and affect that may reflect underlying profiles of challenge and strength in youth with ASD.

Lay Summary

Camouflaging refers to ways individuals with autism spectrum disorder (ASD), especially females, mask symptoms. Compensation occurs when a person's observed behavior appears more

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Conflict of Interest

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typical than what would be expected based on underlying ability and symptoms. The study explored camouflaging and compensation differences in 161 youth with ASD. Findings suggest sex-based differences with females showing better vocal expression. However, several compensation differences were observed with the High compensators showing stronger social communication and rapport. A more nuanced consideration of camouflaging using compensation models reveal subtle differences in underlying challenge and strength.

Keywords

autism; camouflage; female; sex; compensation; anxiety

Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impairments in social communication and restricted, repetitive behaviors and interests (APA, 2013). With expanding prevalence rates worldwide, a male bias emerges with a male-to-female ratio of 4:1 (Maenner et al., 2020). Evidence suggests the true male-to-female ratio may be closer to 2:1 or 3:1 due in part to underdiagnosis of females (Kim et al., 2011; Loomes, Hull, & Mandy, 2017) and a unique phenotype of ASD among females (Kreiser & White, 2014; Mandy et al., 2012; Uljarevic et al., 2020).

Further complicating diagnostic practices, many gold-standard diagnostic measures, such as the Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2012) and the Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994), were developed from a male-centric perspective and lack sex-based norms (McPartland, Law, & Dawson, 2016). In alignment with this challenge, several studies have identified sex-based differences in ASD diagnostic traits on the ADOS and ADI-R (Mandy et al., 2012; Pilowsky, Yirmiya, Shulman, & Dover, 1998; Ratto et al., 2018; Van Wijngaarden-Cremers et al., 2014). Given these findings, a lower diagnostic threshold may be warranted for females (Pugliese et al., 2015) and continued investigations to understand the expression of ASD in females (Smith, Pugliese, Corbett, & White, 2017).

In addition to diagnostic characteristics, specific cognitive domains (e.g., attention to detail, dexterity in executive function) appear modulated by sex, such that females with ASD without co-occurring intellectual impairment demonstrate abilities similar to neurotypical females and superior to males with ASD (Lai et al., 2012). Regarding social cognition, female children with ASD show greater visual attention to faces compared to males with ASD (Harrop et al., 2019). In the largest cohort of individuals with ASD to date examining restricted, repetitive behaviors and interests (RRB), male sex was associated with more repetitive motor behaviors (Uljarevic et al., 2020). Some studies report that females without co-occurring intellectual impairment endorse higher internalizing problems (e.g., anxiety, depression) than males with ASD (Kreiser & White, 2014), similar to well-documented sex-based patterns among typically-developing adolescents and adults (Allgood-Merten, Lewinsohn, & Hops, 1990; Altemus, Sarvaiya, & Neill Epperson, 2014; Kendler & Gardner, 2014). Other studies do not report sex-based differences in internalizing problems among

adults (Lai et al., 2011; McLennan, Lord, & Schopler, 1993), and thus, continued investigation of internalizing problems in the unique context of ASD is warranted.

Language differences have also been documented between sexes, such that adolescent and adult females with ASD without intellectual impairment exhibit more appropriate language skills, especially in social interactions (Halladay et al., 2015; Hiller, Young, & Weber, 2016; Messinger et al., 2015). Pragmatic language markers (e.g., ugh vs um during conversational pauses) (Parish-Morris et al., 2017) and more cognitive process words may distinguish girls and boys with ASD (Boorse et al., 2019). Of note, developmental timing may influence language abilities in females with ASD. For example, a study in very young children reported greater communication deficits among females with ASD compared to males (Hartley & Sikora, 2009). Additionally, females with ASD and childhood language delay show a pattern of lower performance IQ in adulthood, an association not present in males with ASD (Lai et al., 2011). Cultural factors may also play a role as greater expectations for adolescent and adult females to engage in adaptive social communication and behavior are prominent and may contribute to sex-based differences in ASD (Robinson, Lichtenstein, Anckarsater, Happe, & Ronald, 2013; Rose & Rudolph, 2006). In fact, cultural expectations and the camouflaging of ASD symptoms have been proposed as robust factors in the underdiagnosis of ASD among females (Dworzynski, Ronald, Bolton, & Happe, 2012; Gould & Ashton-Smith, 2011).

The term *camouflaging* has been used in ASD to refer to the process by which individuals with ASD hide or mask symptoms that may be viewed as socially unacceptable and/or artificially perform social behaviors considered more acceptable (Campkin, 2000; Hull et al., 2017; Lai et al., 2017). Initially, this term was used in studies of sex ratios (Wing, 1981) but, over time, it has been used to better understand the unique phenotype of ASD in females (Hull et al., 2020; Hull & Mandy, 2017; Lai, Baron-Cohen, & Buxbaum, 2015). In fact, under-identification of autism in females may be driven, in part, by use of camouflaging among females (Dworzynski et al., 2012; Kopp & Gillberg, 1992; Lai et al., 2015). Female adolescents and adults with ASD may camouflage their social struggles by imitating or memorizing the social behaviors of others (Gould & Ashton-Smith, 2011; Tierney, Burns, & Kilbey, 2016), which may explain why females' significant social difficulties may go unnoticed (Dean, Harwood, & Kasari, 2017).

To better understand the causes and consequences of camouflaging, Cage and Troxell-Whitman (2019) surveyed 262 autistic people and their results revealed adult women have more "conventional" reasons for camouflaging (e.g., work); however, there appear to be mental health costs associated with high, chronic camouflaging to include higher rates of self-reported anxiety (Livingston, Colvert, Social Relationships Study, Bolton, & Happe, 2019). Drawing upon experiences of camouflaging among autistic adults, the Camouflaging Autistic Traits Questionnaire (CAT-Q; Hull et al., 2019) was developed to understand the nature, causes, and consequences of social camouflaging among adults with and without ASD. In a recent study, autistic adult females endorse higher masking and assimilation as compared to males, based on the CAT-Q (Hull et al., 2020). Although a self-reported questionnaire of camouflaging is not yet available for adolescents, significant sex differences in camouflaging behaviors emerge in adolescence and appear related to age (i.e., higher

camouflaging endorsed at higher ages) (Jorgenson, Lewis, Rose, & Kanne, 2020) and specific camouflaging behaviors (e.g., social reciprocity) (Wood-Downie et al., 2020).

Within the ASD literature, an abundance of terminology has emerged to describe different processes encompassed by the overarching concept of camouflaging (Livingston, Colvert, et al., 2019). First, behavioral masking describes regulation (increasing or decreasing) of social behaviors in order to lessen the surface appearance of ASD symptoms during social interactions, yet masking does not equate to active or seamless engagement in those interactions (Lai et al., 2017). Examples of behavioral masking include the suppression of ASD-related behaviors (e.g. motor stereotypies, repetitive behaviors) (Wiskerke, Stern, & Igelström, 2018) or intentionally maintaining appropriate eye contact (Lai et al., 2017). Second, mimicry (or imitation) describes modification and use of novel social behaviors to copy peers' social behaviors (e.g., gestures, facial expressions) (Hull & Mandy, 2017), planning and rehearsing conversations ahead of time, and guiding conversations toward topics of interest. Because mimicry strategies are relatively inflexible, transfer poorly to new social contexts, and tend to be more obvious to neurotypical peers, they often support reciprocal participation in low-demand social interactions, but prove ineffective in high-demand social situations due to persisting deficits in social cognition (Livingston, Colvert, et al., 2019; Livingston & Happe, 2017; Livingston, Shah, & Happe, 2019). Third, accommodation (or adaptation) strategies describe behaviors which help accommodate, without necessarily altering, differences in social behavior such as incorporating humor or intelligence into social interactions or seeking employment opportunities in which non-social skills are valued more highly than social skills (Livingston, Shah, et al., 2019). Fourth, compensation strategies involve complex, flexible processes for engaging in successful social cognition at an observable level during interactions, despite significant internal challenges (Livingston, Colvert, et al., 2019; Livingston & Happe, 2017). Compensation strategies often involve pattern recognition and social observations of others to make inferences about others' cognitive and emotional states (i.e., Theory of Mind, TOM) and to guide appropriate social responses. Camouflaging and compensation describe behavioral modifications made by autistic individuals to blend into social situations (Hull et al., 2017; Lai et al., 2017), yet compensation may extend the idea of mere masking/suppression of autistic traits by accounting for alternative cognitions designed to circumvent one's underlying cognitive difficulties (Livingston, Colvert, et al., 2019). As described by Livingston and colleagues (2019), "The outcome of compensation is that an individual's behavioural presentation may appear less severe than otherwise predicted by their underlying cognitive abilities/atypicalities" (p. 102; (Livingston, Colvert, et al., 2019).

Due to the subjective nature of behavior, the methods used to quantify camouflaging in ASD vary significantly between studies. Lai et al. (2017) quantified social camouflaging as discrepancies between an individual's external behavior in social contexts (ADOS-2 scores) and self-rated ASD symptoms and social cognitive ability. Results showed adult women had higher camouflaging scores than men, although significant variability in each group was observed. This approach may not be as useful in children with ASD who may lack the self-awareness and/or ability to self-report on their ASD symptoms and/or their attempts to camouflage ASD symptoms (Huang et al., 2017). Livingston et al. (2019) operationalized compensation as the discrepancy between clinician-rated social behavior on the ADOS-2

and performance on a TOM task. Therefore, Livingston's approach may be more appropriate for adolescents with ASD, as combining clinician-rated behavior with performance on social-cognition tasks bypasses the potential obstacle of using self-report measures, while identifying individuals who engage in successful compensation and who would therefore be most likely to evade diagnostic detection.

Recently, some studies examined social camouflaging behaviors among adolescent and adult males and females with ASD and compared to sex-matched TD peers. Sedgewick, Hill, and Pellicano (2018) used qualitative interviews and an assessment of friendship and found similar themes between the social experiences of ASD and TD girls, suggesting that biological sex, rather than diagnosis, plays a vital role in how adolescents with ASD experience social relationships (Sedgewick et al., 2018).

Despite these various approaches, few studies have incorporated direct observation of youth with ASD in order to understand camouflaging in the context of social behavior. While observing social behavior on school playgrounds, Dean et al. (2017) found that girls with and without ASD spent time jointly engaged unlike both groups of boys. However, girls with ASD spent a significant portion of time alone and "flitted" from joint engagement to solitary activities, rather than between engagements with peers as the TD girls did. Meanwhile, Rynkiewicz (2016) used an automated coding program to examine gesture use during the ADOS-2 and found girls with ASD used gestures more vividly compared to boys with ASD. However, Head, McGillivray, and Stokes (2014) found no significant differences between girls with ASD and TD boys on friendship quality and understanding, though boys and girls with ASD differed from one another. As the previous review illustrates, different definitions and approaches are used to characterize and elucidate the camouflaging construct in the ASD phenotype. Findings from multiple studies on children and adults with ASD suggest a developmental effect to camouflaging (Lai et al., 2012; Livingston, Colvert, et al., 2019; Uljarevic et al., 2020); yet studies on adolescents are sparse. Given that adolescence is a critical developmental period in which internalizing symptoms and sex-based differences emerge in typically-developing youth, the study of camouflage and compensation during adolescence in ASD is vital.

Therefore, the purpose of the present study was to explore diagnostic, sex-based and compensatory differences in youth with ASD (Ratto, Turner-Brown, Rupp, Mesibov, & Penn, 2011). Aim 1 focused on examining sex-based differences in diagnostic traits (Lord et al., 2012). Based on previous research (Mandy et al., 2012; Pilowsky et al., 1998; Ratto et al., 2018; Van Wijngaarden-Cremers et al., 2014; Volkmar, Carter, Sparrow, & Cicchetti, 1993), it was hypothesized that females with ASD would evidence fewer RRB than males with ASD, yet social affect (SA) would be comparable across the sexes. Aim 2 focused on sex-based social communication within the context of an ecologically-valid paradigm (Ratto et al., 2011; Smith, Simmons, Corbett, Lerner, & White, 2019; White, Scarpa, Conner, Maddox, & Bonete, 2015). Based on previous research (Halladay et al., 2015; Hiller et al., 2016; Messinger et al., 2015; Parish-Morris et al., 2017), it was hypothesized that females with ASD would show better social and communication behaviors. Aim 3 used a compensation-based model (Livingston, Colvert, et al., 2019) to examine diagnostic and social communication differences; it was hypothesized that High vs. Low Compensation

groups with ASD would demonstrate higher verbal IQ as well as better social and communication behaviors. Finally, an exploratory aim compared potential sex and compensation differences for self-reported state and trait anxiety following the social paradigm.

Methods

Participants

The sample included 161 youth with an average to above average cognitive ability between 10:0-16:11 years consisting of 115 males and 46 females. Data were collected as part of a multisite randomized clinical trial targeting social skills (Corbett, MH114906), which only included pre-treatment variables when the participants were between 10-years-0-months to 16-years-11-months of age. The research was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). The Vanderbilt Institutional Review Board (IRB) approved the single IRB multisite study (Vanderbilt University Medical Center, University of Alabama and Stony Brook University). Informed written assent/consent was obtained from all study participants and care providers, respectively, prior to inclusion in the study. Participation required two research visits to the University. On visit 1, the diagnostic and cognitive measures were administered and on visit 2, the neuropsychological and social communication measures were given.

Diagnostic and Screening Procedures

Inclusion criteria required participants to have a diagnois of ASD, be verbally fluent and without intellectual disability, described below. The diagnosis of ASD was based on the Diagnostic and Statistical Manual-5 (APA, 2013) and confirmed by: (1) a previous diagnosis by a psychologist, psychiatrist, or behavioral pediatrician with autism expertise, (2) current clinical judgment, (3) corroborated by the Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2012), administered by research-reliable personnel and 4) the Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003).

Autism Diagnostic Observation Schedule-Second Edition (ADOS-2; Lord et al., 2012) is a semi-structured play and interview-based instrument used to support the diagnosis of ASD. Module 3, for verbally fluent children and adolescents, was used for all participants. The measure provides at total score as well in Social Affective (ADOS SA) and Restrictive and Repetitive Behavior (ADOS RRB). A minimum score of 7 was required for inclusion. The internal consistency is Cronbach's alpha = 0.87-0.92 for SA domain, and Cronbach's alpha = 0.51-0.66 for RRB domain (Lord et al., 2012). The test-retest reliability correlations range from 0.68-0.92 for SA, RRB, and overall total scores.

Social Communication Questionnaire Lifetime (SCQ; Rutter et al., 2003) is a screening instrument for symptoms of ASD. The measure was used as an additional index of parent-reported ASD symptom presentation across the lifetime. The internal consistency is good (alpha = 0.90; Sensitivity = 0.85 and Specificity = 0.75) (Berument, Rutter, Lord, Pickles, & Bailey, 1999).

Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II, Wechsler, 2011) is a measure of cognitive ability used to obtain an estimate of the child's intellectual functioning. Due to the social and cognitive demands of the intervention study from which the sample was drawn, participants were required to have an absence of intellectual disability (IQ ≥ 70 for inclusion). The psychometric properties of the WASI are solid; test-retest reliability 0.83-0.94 for the stability coefficients for the subtests, and 0.90-0.96 for the composite scores.

Measures

The *NEuroPSYchological Assessment Second Edition* (*NEPSY-II;* Korkman, Kirk, & Kemp, 2007) is a battery of tests developed to examine various neuropsychological domains in children and adolescents between 3-to-16 years. For the current study, only the Theory of Mind test was used which measures verbal and contextual elements of the ability to understand others' perspectives, intensions and beliefs. It provides raw and percentile scores. Test-criterion validity for children with ASD has shown deficits on the TOM subtest compared to the normative sample, revealing expected clinical differences (Korkman et al., 2007). Other research has supported its use in children and adolescents with ASD (e.g., Corbett et al., 2016; Loukusa, Makinen, Kuusikko-Gauffin, Ebeling, & Moilanen, 2014; Miranda, Berenguer, Rosello, Baixauli, & Colomer, 2017; Rice, Wall, Fogel, & Shic, 2015). The test-retest reliability for the TOM subtest is good 0.84 (Brooks, Sherman, & Strauss, 2009; Korkman et al., 2007).

The *Contextual Assessment of Social Skills (CASS)* is a peer-based role-play, observational measure developed to ascertain different aspects of social functioning in youth and young adults with ASD (Ratto et al., 2011). While conducted in a clinic-setting, it is conceptualized as an ecologically-valid social interaction protocol. Participants engage in two sequential three-minute role-play scenarios with two opposite-sex TD confederate[1] peers who were fully trained, provided written consent to participate in the study and were paid $20 per hour. For each site there was an average of 6 confederates per cohort. The confederate age ranged from 9 to 22 years of age; however, confederates gave the appearance of being in middle-to-high school. Confederates were unknown to the participants and did not come from the same school. Prior to their involvement, confederates participated in didactic training which addressed verbal and nonverbal behavior during the CASS and included structured rehearsal. Feedback was provided to each confederate regarding their performance during training, as well as after each CASS administration, as needed. Confederates and research participants were instructed to "get to know one another," but specific topics of discussion were not provided, therefore conversations varied across dyads. Prior research using the CASS has found that confederates largely follow instructions during the CASS-Interested conversation, and controlling for variance in confederate behavior did not significantly alter analyses examining metrics of social cognition or social behavior in participants with ASD (Simmons et al., 2020).

[1]The term "confederate" is a psychological term used to describe a research helper who participates in an experiment pretending to be a participant yet is actually part of the research team.

The two conversations are led by the confederate who acts with either *interested* or *bored* (CASS-I and CASS-B, respectively) demeanor during the conversations. Each scenario is videotaped and coded by trained, masked observers. The coded domains involve asking questions, topic changes, vocal expressiveness, gestures, positive affect, kinesic arousal, social anxiety, overall involvement, and quality of rapport. Scores fall on a 7-point Likert scale such that "1" reflects low/impaired performance and "7" reflects a high/skilled level in a particular domain or behavior. The inter-rater reliability for all 9 items on the CASS is good, ICC = 0.83 (Ratto et al., 2011).

CASS Conditions.—Although the CASS features two conditions, the utility of the CASS-B as a treatment outcome for social skills has been questioned (Dolan et al., 2016; Laugeson, Gantman, Kapp, Orenski, & Ellingsen, 2015; Rabin, Israel-Yaacov, Laugeson, Mor-Snir, & Golan, 2018; White et al., 2015). Additionally, validation of confederate behavior across the two conditions has revealed lower adherence to the behavioral protocol during the *Bored* compared to the *Interested* condition (Simmons et al., 2020; Smith et al., 2019). Therefore, for the current study we focused exclusively on the *CASS-I*. The following four domains were initially selected based on clinical judgement and previous research suggesting possible sex-based differences. *Vocal Expressiveness*, which is the degree to which the participant varies the tempo, pitch, tone, volume and/or rhythm of his/her speech. *Gestures*, defined as the frequency and skill with which the participant uses two types of gestures: descriptive/conventional gestures and emphatic/emotional gestures. *Positive Affect*, which is the degree to which the participant demonstrates positive affect through facial and physical cues. *Overall Involvement*, which is a global rating of the participant's level of involvement and interest in the conversation considering both verbal (e.g., questions, statements) and nonverbal (e.g., eye contact, posture) behavior. The remaining CASS measures were also explored. *Ask Questions* refers to the number of times the participant asks questions. *Topic Changes* is the number of times the participant initates a change in the topic of conversation. *Kinesic Arousal* refers to the amount of physical movement exhbited by the participant. *Social Anxiety* involves verbal and nonverbal markers of anxiety (e.g., fidgeting, trembling, avoidance of eye contact). *Quality of Rapport* is degree to which rapport and reciprocity are established between the participant and confederate.

CASS Coders.—All CASS video coders completed didactic training and coded eight training videos provided by the instrument developers (Ratto et al., 2011). Each coder achieved reliability (i.e., 80% overall agreement with 'Gold Standard' codes) on these training videos prior to coding CASS data. Trained research personnel at each site double-coded 10% of their site's study videos to maintain coding calibration. Additionally, an expert coding team (i.e., graduate student and licensed psychologist) double-coded an additional 10% of study videos (18 videos, total) across all sites to assess for coder drift. Intraclass correlations were computed for each of the four items of the CASS *Interested* conversation (ICC (2,2) .85 – .86), (Shrout & Fleiss, 1979) reflecting strong cross-site agreement.

The *State Trait Anxiety Questionnaire for Children (STAI-C)* is a self-report questionnaire measuring State (current) and Trait (enduring) anxiety (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). It has been used in studies with TD youth (e.g., Muris, Steerneman, Merckelbach, Holdrinet, & Meesters, 1998) and youth with ASD (Lanni, 2012; Park, Park, Kim, & Yoo, 2013; Simon & Corbett, 2013). Alpha reliability ranges from 0.78-0.91; test-retest reliability for the STAIC-Trait is 0.65-0.71 (Julian, 2011). Participants were administered the STAIC immediately following the CASS (Ratto et al., 2011). Higher scores reflect more anxiety.

Statistical Analyses

Independent sample *t*-tests were conducted to test for differences between the groups in demographic and diagnostic variables. If the assumption of normality was violated, the equivalent nonparametric test was used. The assumption of homogeneity of variance was tested with Levene's test of homogeneity, with a Welch degree of freedom approximation used when the assumption was violated. Since we were not concerned with bias from multiple comparisons and sought to reduce Type II error, we elected to to run a series of *t*-tests. Effects sizes are provided using Cohen's *d* (Cohen, 1988) representing small (0.2), medium (0.5), and large (0.8) effects.

For Aims 1 and 2, to examine sex-based (female vs. male) differences in cognition (VIQ, PIQ), social cognition (TOM) and social communication (Vocal Expression, Gestures, Positive Affect, Overall Involvement), planned independent sample *t*-tests were performed with alpha 0.05. Due to the preliminary nature of the study, we did not alpha correct for multiple comparisons and instead provide effect sizes.

For Aim 3, to examine compensation-based differences, the following procedures were performed modeled after the framework presented by Livingston and colleagues (Livingston, Colvert, et al., 2019). Participants were separated into four groups based on median split TOM performance on the NEPSY (Mdn = 23, Range 3 - 28) resulting in groups with good TOM (≥ 23) and poor TOM (< 23). Additionally, participants were split based on ADOS SA score (Mdn = 8) forming groups with good ADOS SA (≤ 8) and poor ADOS SA (> 8). This resulted in four groups reflecting the TOM and ADOS SA dimensional space depicted in Figure 1. The four groups were High Compensation (good ADOS SA+Poor TOM, n = 28), Low Compensation (poor ADOS SA+poor TOM, n = 47), Deep Compensation (good ADOS SA+good TOM, n = 54) and Unknown (poor ADOS SA+good TOM, n = 30) groups.

Since the central goal was to compare High vs. Low compensators, analyses focused primarily on comparison of these groups. However, for completeness, independent sample *t*-test analyses were run comparing the Deep vs. Unknown groups as well.

Exploratory analyses using independent sample t-tests compared self-reported state and trait anxiety following the CASS based on sex and compensation groups. Statistical analyses were performed using SPSS (IBM Corp. Released 2019. IBM SPSS Statistics for Mac, Version 26.0, Armonk, NY: IBM Corp).

Results

Preliminary analyses

The characteristics of the sex-based groups are presented in Table 1. There were no significant differences based on mean age (see Table 1). Preliminary analyses also revealed there were no sex-based group differences for Verbal, Performance or Full Scale IQ between males and females. Therefore, age and IQ were not included as covariates in the models.

Primary analyses

Diagnostic differences on the ADOS were explored between females and males with ASD hypothesizing similar profile on the ADOS SA and differences on ADOS RRB. The hypothesis was confirmed; as shown in Table 1, there were no significant differences for SA, however, sex differences for RRB were found ($p = 0.003$, $d = 0.54$).

Results of the sex-based planned *t*-tests are shown in Table 1. For social cognition (TOM) there was a trend based on sex with females showing a modestly better performance than males with ASD.

In regards to Aim 2, it was hypothesized that social and communication behaviors on the CASS would differ based on sex such that females with ASD would show better Social (Positive Affect and Overall Involvement) and Communication (Vocal Expressiveness, Gestures) behaviors. As shown in Table 1, females evidence more Vocal Expressiveness than males with ASD (p=0.05, d=0.35). However, the remaining variables were not significant.

For Aim 3, we explored group differences based on the compensation model presented by Livingston (Livingston, Colvert, et al., 2019) with an emphasis on the High Compensation (High Comp) vs. Low Compensation (Low Comp) groups. A graphic representation is presented in Figure 2 based on performance on the ADOS SA and TOM. The Compensation distribution based on sex is presented in Table 2 using chi-square. There was a marginal significant difference between the four compensation groups and sex (χ^2 (3)=7.76, p=0.05). Post-hoc Z score analysis indicated that males were more likely to be in the Low Comp group relative to females, while females were more likely to be in the Unknown group relative to males (both $p<0.05$).

Direct comparison results between the High Comp vs. the Low Comp groups are presented in Table 3. There were no differences based on Verbal or Performance IQ. However, the High Comp group showed stronger social communication on the CASS with regards to Vocal Expression with a medium effect size ($p = 0.01$, $d = 0.62$). There were also significant differences and medium effects for Social Anxiety (p=0.004, d=0.72) showing higher anxiety in the Low Comp, and Overall Rapport (p=0.02, d=0.56) showing better rapport in the High Comp.

Although the focus of the study was on High vs. Low compensators, for completeness analyses pertaining to social communication were run comparing the Deep Comp vs. Unknown Comp groups. Regarding the CASS, Vocal Expression was significant ($t(82) = 2.17$, p=0.03, d=0.50), reflecting better performance for the Deep Comp group compared to

the Unknown Comp group. However, there were no differences for Gesture ($t(82) = 1.15$, $p = 0.25$, $d = 0.27$); Positive Affect ($t(82) = 1.56$, $p = 0.12$, $d = 0.12$); and Overall Involvement ($t(48.61) = 1.63$, $p = 0.11$, $d = 0.40$).

The results for the Compensation groups on the CASS are presented in Figure 2, revealing similarities between the High Comp and Deep Comp groups (e.g., TOM, vocal expression); therefore, exploratory analyses were conducted to examine potential differences (see Table S1). Significant differences were demonstrated for Gestures, indicating better use of gestures in the Deep Comp vs. the High Comp group ($t(73.28) = -2.64$, $p = 0.01$, $d = 0.55$) as well as greater use of Asking Questions ($t(80) = -1.96$, $p = 0.05$, $d = 0.46$). In regards to the Unknown group, the only significant difference pertained to anxiety such that the Unknown Comp group expressed more Social Anxiety than the High group ($t(56) = 2.42$, $p = 0.02$, $d = 0.63$).

Finally, as an exploratory aim we examined self-reported anxiety using the STAI-C and there were no sex-based or High vs. Low Comp group differences on the STAI-C State or Trait anxiety. However, the Unkown Group endorsed significantly higher State anxiety compared to the High Comp group ($t(56) = -2.28$, $p = 0.03$, $d = 0.60$) (see Table S2).

Discussion

In an effort to elucidate phenotypic profiles that may be associated with camouflaging, the current study aimed to examine sex-based and compensation models in a sample of comprehensively evaluated youth with ASD with a focus on social communication in the context of an ecologically-valid paradigm (Ratto et al., 2011). Exploration into sex-based diagnostic trait differences using the ADOS-2 (Lord et al., 2012) revealed significant differences, as females with ASD showed fewer restricted and repetitive behaviors than males, supporting the first hypothesis. This finding corroborates previous research identifying sex-based differences on core diagnostic traits (Mandy et al., 2012; Pilowsky et al., 1998; Ratto et al., 2018; Van Wijngaarden-Cremers et al., 2014; Volkmar et al., 1993).

Additionally, females and males showed similar Social Affect scores on the ADOS-2, which is consistent with prior studies (Mandy et al., 2012; Pilowsky et al., 1998; Ratto et al., 2018; Van Wijngaarden-Cremers et al., 2014; Volkmar et al., 1993). The observation of fewer RRBs, yet similar SA, among females during the ADOS-2 in this study, may extend previous findings suggesting females engage in camouflaging behaviors to intentionally suppress ASD-related behaviors (e.g., repetitive behaviors) during semi-structured observational assessments (Wiskerke et al., 2018). It is acknowledged that since we did not have an additional measure of RRB for comparison, it may be the case that females in the current sample evidence lower RRBs. Alternatively, the ADOS may not be an optimal measure of RRBs in females. Given the reliance upon observable behaviors in scoring the ADOS-2, it is likely that higher camouflaging behaviors among females with ASD may contribute to the underdiagnosis of ASD in females. The male-centric perspective and lack of sex-based norms on the ADOS-2 and most diagnostic measures (McPartland et al., 2016) limit the generalizability of this finding and thus, future research is warranted. Recently, based on the largest collected dataset on females already diagnosed with ASD (n = 1,463), Kaat and colleagues (Kaat et al., 2020) reported that sex differences on most diagnostic

measures were small and may not have clinical relevance. However, if a male-centric measure is used to identify sex-based differences, then conclusions from it are inherently biased.

The similarity between females and males on the ADOS SA suggests that context may be relevant. The ADOS pulls for ASD social communication characteristics and was designed to elicit behaviors that are fundamental, automatic, and hard to mask; therefore it may be more difficult to mask such intrinsic ASD behaviors. In contrast, the context of the CASS is a naturalistic paradigm involving peers that may provide more opportunity to camouflage. Additionally, it has been shown that a key motivation for camouflaging is the desire to increase connection and relationship with others (Hull et al., 2017). Given that camouflaging strategies are intended to minimize core social communication difficulties (Campkin, 2000; Lai et al., 2017), a naturalistic paradigm was used to detect potential sex-based differences in camouflaging behaviors among youth. The CASS paradigm emulates everyday conversations with peers with a focus on key social (e.g., Positive Affect and Overall Involvement) and communication (e.g., Vocal Expressiveness, Gestures) behaviors. Moreover, it involves same-age peers that may promote camouflaging behaviors in youth with ASD in order to appear more neurotypical to present themselves in a more favorable light (Hull et al., 2017). In the current study females were differentiated by marginally significant better vocal expression, which appears to corroborate previous findings showing females with ASD exhibit more appropriate language skills in social interactions (Halladay et al., 2015; Hiller et al., 2016; Messinger et al., 2015; Parish-Morris et al., 2017). While the specific factors that may contribute to sex-based differences in vocal expression remain unclear, differences in cultural expectations across sexes likely play a role given the higher expectations of females to engage in appropriate reciprocal social communication (Robinson et al., 2013; Rose & Rudolph, 2006). With divergent sex-based expectations in social interactions, females with ASD may be more likely to mask unusual speech and prosody characteristics in order to engage in these interactions.

Interestingly, no sex-based differences in gestures were observed in the present study, inconsistent with our hypothesis as well as findings from previous studies (Dean et al., 2017). In previous research females used gestures more vividly during social interactions on the ADOS-2 than male children with ASD (Rynkiewicz et al., 2016); however, less is known about these behaviors in adolescent samples. Additionally, distinct observational measures using a semi-structured (ADOS-2) vs. a naturalistic paradigm (CASS) may account for discrepant findings regarding gesture use. As noted above, the ADOS explicitly pulls for autistic behaviors and is conducted by adult clinicians; in contrast, the CASS utilizes a more natural context and is performed with peers. Sex-based differences may become apparent with closer examination of the more nuanced aspects of social interactions, such as vocal expression.

Another way to explore compensation is to examine phenotypes based on a proposed four group model (Livingston & Happe, 2017). The Livingston compensation-based model (Livingston, Colvert, et al., 2019) was adopted in the present study and compensation was operationalized as the discrepancy between social communication and interaction behaviors (ADOS SA; perceived ability) and social cognition performance on a Theory of Mind task

(NEPSY TOM; actual ability) (Livingston, Colvert, et al., 2019). This resulted in four groups stratified by compensation level: High, Low, Deep, and Unknown. While the High Compensation group showed no differences on Verbal or Performance IQ as compared to the Low Compensation group, there was evidence of better social communication with a novel peer, particularly for Vocal Expression. This index measures the degree to which the individual appropriately varies the quality of his/her speech, an important component of pragmatic language. The way someone uses language can help them to fit in and to appear more normal when conversing with others. In this way, better vocal expression may be seen as an important compensatory behavior.

It is worth highlighting that vocal expressiveness differentiated the groups based on sex and compensation functioning level. Specifically, females showed more vocal expression as did the High and Deep compensation groups. These overlapping findings indicate that the ability to modulate the tempo, pitch, tone, volume and/or rhythm of speech appears to be a key determinant of better functioning and camouflaging regardless as to how it is defined. The findings suggest that females and high compensators are better at using these more subtle language skills and hint at the importance of language use and mechanics (e.g., vocal expression) in understanding compensation models. In terms of clinical application, speech and behavioral therapies targeting not only vocabulary use, but also the way in which an individual communicates, may be a subtle marker of not only how they are perceived (e.g., meeting threshold for a diagnosis) but how they are able to camouflage their underlying difficulties understanding social cues. While vocal expression is often a targeted skill in speech and language therapy, it is difficult to teach because it must go beyond imitation (Grossman, Edelson, & Tager-Flusberg, 2013) and often does not generalize across situations and settings (Lanovaz & Sladeczek, 2012).

With regards to IQ, group differences did not emerge between youth in the High and Low Compensation groups of the present study, despite findings of higher IQ among High Compensators by Livingston and colleagues (2019). This may be accounted for by a slightly smaller sample size and the inclusion of individuals with subthreshold autism symptom presentation by Livingston and colleagues (2019).

It is important to highlight that results suggest resiliency among youth in the High Compensation group, as they may have had to put in more work to overcome their underlying social cognitive challenges in order to show a more normative presentation. This is underscored by the fact that the High Compensation group performed similarly to the Deep Compensation group (e.g., TOM, vocal expression); however, working to appear normal is effortful and likely comes at a cost to the individual. This notion is supported by qualitative research in adults with ASD who report psychological and physical exhaustion as a persistent negative consequences of camouflaging (Hull et al., 2017). Despite challenges in social cognition, the high compensators are able to utilize social and language skills to appear more engaging. This is reflected in their ADOS-2 performance, vocal expression, and good overall rapport during conversations with peers. Although high compensators demonstrate better social and communication skills, they did not exibit more social anxiety while engaging with peers compared to the other groups. Alternatively, the Social Anxiety variable of the CASS may account for some behaviors (e.g., reduced eye contact) that are

common in both autistic and socially anxious people. This may suggest an alternative explanation to elevated Social Anxiety scores in the Low Compensation group; however, continued investigations are needed to elucidate this potential overlap in behaviors. Moreover, immediately following the social exchange the High Compensation group did not endorse greater state or trait anxiety compared to other groups. In the Livingston and colleagues (2019) study, higher anxiety in the subscales of social phobia, panic disorder, and genralized anxiety disorder was self-reported by the High Compensation group on the Revised Children's Anxiety and Depression Scale (RCADS; Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000) during a follow-up visit. This may suggest that individuals who engage in camouflaging behaviors may endorse more anxiety in these areas as an indication of the significant effort to both initiate and sustain sophisticated social interactions using less social cognition and perspective-taking skills, which may be associated with mental health costs (Cage & Troxell-Whitman, 2019). If such is the case, treatments that promote camouflaging may unintentionally increase the risk of negative outcomes (e.g., mental health problems) (Bottema-Beutel, Park, & Kim, 2018).

In contrast to the findings reported by Livingston and colleagues (2019), the present study observed higher social anxiety on the CASS in the Low Compensation group, and no group differences in state or trait anxiety on the STAI-C after the CASS interaction. These distinct findings across studies may be accounted for by various reasons including different measurements (e.g., CASS coding, STAI-C, RCADS), time of assessment (i.e., immediately after social interaction in the present study and at a later date in the Livingston and colleagues (2019) study), and rater (i.e., Social Anxiety on CASS rated by coder blind to study conditions and social anxiety on RCADS rated by adolescent). Measurement of anxiety on the STAI-C immediately following the social interaction in the present study may afford a closer examination of adolescents' perceived anxiety during social interactions than that observed by Livingston and colleagues (2019). Findings from this study may also suggest that adolescents in the High and Low Compensation groups may not experience state or trait anxiety differently following interactions, but anxious behaviors may be more evident among the Low Compensation groups to a third-party rater. These explorations into the overlap between social anxiety and ASD profiles as they relate to camouflaging and compensation are novel. Future studies should investigate the internal and external experiences of anxiety across compensation groups using multimethod (e.g., behavioral coding, self-report), multi-informant (e.g., adolescent, clinician) measurements.

Findings from the present study show that females with ASD demonstrate fewer RRB and better vocal expression during the ADOS-2 and CASS, respectively than their male counterparts, no differences in anxiety were reported. Nevertheless, future studies should continue to investigate anxiety and potential mental health costs associated with varying levels of compensation. Future longitudinal studies are needed to examine the potential mechanisms of the relationship between compensation and mental health problems, particularly for youth in the High Compensation group in a developmental period associated with heightened emotional difficulties (Mendle, 2014).

While the focus of the current study has been on those who are conceptualized as High compensators, unique profiles emerge for the other groups. The Deep Compensation group

demonstrate strength in social communication (asking questions, gestures) and perspective taking (e.g., TOM). It is plausible that they may simply represent a mild form of ASD, or alternatively, they may have good skills and may not be camouflaging during social interactions. In this way, they may be less likely to compensate given a strong alignment of their underlying skill and observed behavior. In contrast, the Unknown group, which represents approximately a third of the female sample, performs more poorly in social communication amidst higher social cognition (e.g., TOM skills). TOM is theoretically linked to ASD but is not part of the diagnostic criteria. Although difficulties in TOM have been associated with individuals with ASD (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Kleinman, Marciano, & Ault, 2001), findings are mixed with robust individual differneces across development and measurement approaches (Scheeren, de Rosnay, Koot, & Begeer, 2013; Senju, Southgate, White, & Frith, 2009; Spek, Scholte, & Van Berckelaer-Onnes, 2010; White, Hill, Happe, & Frith, 2009). Thus, the Unknown group may indeed represent a unique form of compensation, or it may simply reflect population and measurement variability in TOM among youth with ASD. Future research is needed to better understand the clinical presentation of this idiosyncratic group.

Another unique feature of the Unknown group is they showed more social anxiety and reported more state anxiety following their interaction with peers. Therefore, they may be better characterized as the “Anxious” group. In consideration of their better TOM skills, it may be the case that members of the Unknown group are aware of how they are viewed by others and this insight contributes to their anxiety. This finding supports the growing literature of higher stress and anxiety (Cage & Troxell-Whitman, 2019), psychological distress (Beck, Lundwall, Gabrielsen, Cox, & South, 2020) threats to self-perception (Hull et al., 2017), and experiences of thwarted belongingness and suicidality (Cassidy et al., 2020) associated with varying levels of camouflaging behaviors in males and females with ASD. Interestingly, the fact that there were a higher number of females and are comprised of individuals who demonstrate and report more anxiety suggests that this group requires additional characterization to understand and support their needs. Furthermore, research is clearly warranted to examine the shared and unique characteristics of compensatory and camouflaging models as a broader effort to elucidate the social and affective profiles in indivduals with ASD.

Limitations and Future Directions

The present study includes many strengths such as an investigation of sex-based differences and compensation modeling among a large sample of youth with ASD using both standardized assessments and natural paradigms. Despite these strengths, there are several limitations that warrant discussion. First, the study enrolled more females with ASD than many other studies, yet the sex-based groups are uneven and, thus, there are some cells with low numbers of males or females. Post-hoc power analyses revealed we did not have enough power to detect small differences. Therefore, results must be interpreted with caution and future studies with large samples of female participants are needed. Second, the sample is comprised of youth with average to above average cognitive ability (IQ≥70) and thus, the results do not represent the large portion of youth with ASD who have comorbid intellectual disability. Third, the creation of the four compensation groups were pulled from the large

initial sample, but resulted in much smaller groups and preliminary findings. This limits the generalizability of findings and results should be interpreted with caution. Fourth, a large percentage of females (64%) fell into the Deep and Unknown Compensation groups warranting greater exploration into these compensation phenotypes. Fifth, the sample included youth across a relatively wide age span and there may be developmental effects (e.g., age, puberty) that need to be considered in future studies. Finally, we attemped to disentangle potential differences between the compensation groups via exploratory analyses. The model presented by Livingston and colleagues (2019) is novel and provides unique insights into conceptualizing compensatory patterns in autism. Nevertheless, additional approaches that include other underlying factors (e.g., executive function, cognitive functioning) that may facilitate compensation will be important to pursue. Additionally, direct item-level comparisons on the ADOS (e.g., gesture use) and comparable measures on CASS (e.g., gestures) may provide another avenue to explore compensatory strategies. Finally, studies are needed to replicate and extend these findings by exploring potential interaction effects (e.g., sex and group) to illuminate camouflage and compensatory profiles in ASD

The current findings are largely consistent with previous research showing that females with ASD demonstrate fewer restricted and repetitive behaviors, although sex effects may be accentuated due to use of established, male-centric diagnostic instruments (McPartland et al., 2016). Females also use better vocal expressiveness in how they use and modify the quality of their speech resulting in more natural speech patterns during social interactions. However, it is evident from other studies (Livingston, Colvert, et al., 2019) and the current findings that camouflaging does not only apply to females as both sexes fell into the High Compensation group showing stronger social engagement and communication behaviors. Traditional views of social communication deficits in ASD focus on difficulties in the content of communication and interactions; however, findings from the present study highlight that the mechanics (e.g., vocal expressiveness) of social communication may be equally important. With this in mind, youth with ASD would likely benefit from treatments that target both the content and quality of their communication. There is an enduring need to better characterize phenotypic profiles among this highly heterogenous neurodevelopmental disorder in order to refine diagnostic measures, improve diagnostic precision (Mandy et al., 2012; Pilowsky et al., 1998; Ratto et al., 2018; Van Wijngaarden-Cremers et al., 2014), and inform biobehavioral markers and personalized treatments. Finally, the results support a more nuanced consideration of camouflaging using compensation models to reveal subtle differences in cognition, behavior and affect that may reflect underlying profiles of challenge and strength in youth with ASD.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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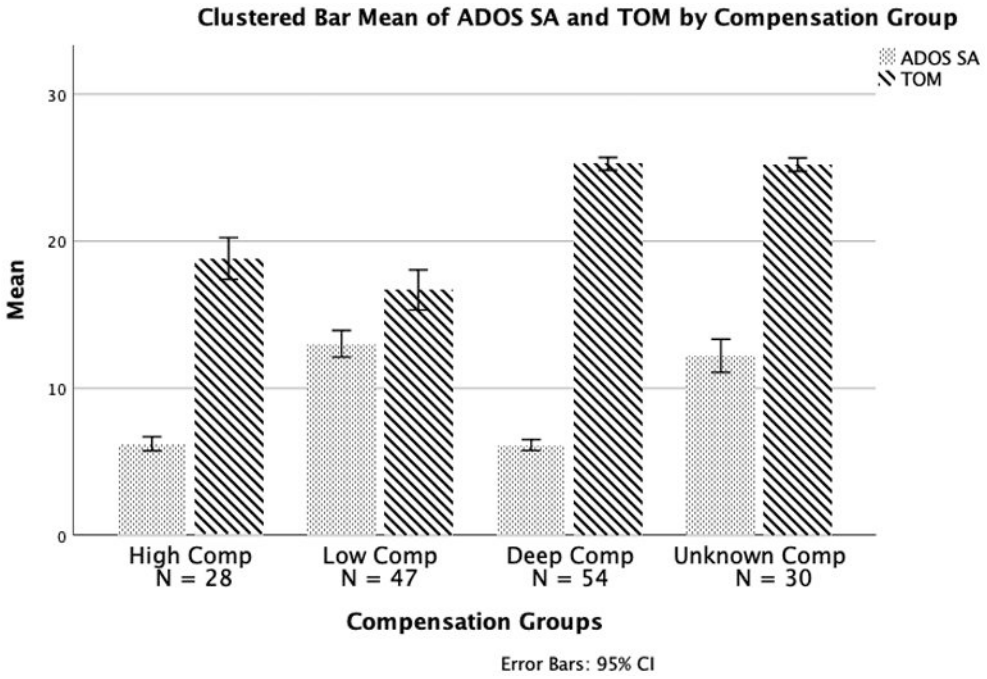

Figure 1. Clustered Bar Graph of ADOS SA and TOM Mean Total Scores by Compensation Group.

Note: ADOS = Autism Diagnostic Observation Schedule; Comp = Compensation, SA = Social Affect; TOM = Theory of Mind. High Compensation = good ADOS + poor TOM, Deep Comp = good ADOS + good ADOS, Low Comp = poor ADOS + poor TOM, Unknown = poor ADOS + good TOM.

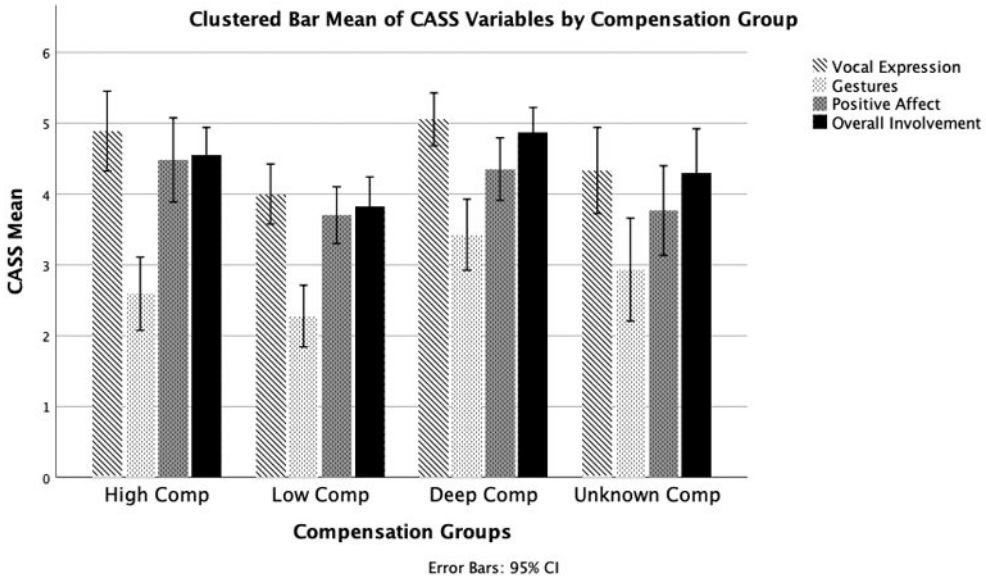

Figure 2. Clustered Bar Graph of CASS Social Communication Variables by Compensation Group.

Note: CASS = Contextual Assessment of Social Communication, Comp = Compensation. High Comp = good ADOS + poor TOM, Deep Comp = good ADOS + good ADOS, Low Comp = poor ADOS + poor TOM, Unknown = poor ADOS + good TOM.

Table 1.

Demographic, Diagnostic, and Social Communicative Traits by Sex.

	Male (n = 115) M *(SD)*	Female (n = 46) M *(SD)*	t	*p*	*d*
Age	12.78 (2.03)	12.93 (1.80)	− 0.45	0.66	0.08
Full Scale IQ	98.98 (18.5)	97.48 (17.3)	0.48	0.64	0.08
Verbal IQ	97.98 (18.5)	100.5 (16.2)	−0.79	0.43	0.15
Performance IQ	99.77 (20.2)	95.69 (19.3)	1.16	0.25	0.21
NEPSY TOM Total	21.12 (5.06)	22.72 (4.75)	−1.86	0.06	0.32
ADOS Composite	7.35 (1.96)	6.47 (2.02)	2.54	0.01**	0.44
Social Affect	9.58 (4.16)	8.67 (3.54)	1.30	0.20	0.23
RRB	3.60 (1.72)	2.71 (1.50)	3.05	0.003***	0.54
CASS					
Vocal Expression	4.44 (1.49)	4.96 (1.52)	−2.03	0.05*	0.35
Gestures	2.87 (1.71)	2.83 (1.81)	0.14	0.89	0.02
Positive Affect	3.93 (1.51)	4.39 (1.72)	−1.68	0.09	0.29
Overall Involvement	4.40 (1.36)	4.35 (1.62)	0.22	0.83	0.03
Ask Questions	3.25 (3.82)	3.63 (3.24)	−0.59	0.56	0.10
Topic Changes	2.67 (2.55)	2.50 (2.16)	−0.39	0.70	0.07
Kinesic Arousal	3.89 (1.26)	4.15 (1.30)	−1.61	0.25	0.20
Social Anxiety	4.13 (1.54)	4.04 (1.56)	0.33	0.74	0.06
Quality of Rapport	4.19 (1.37)	4.24 (1.45)	−0.19	0.85	0.33
STAIC					
State Anxiety	33.28 (7.32)	35.04 (8.51)	−1.31	0.19	0.23
Trait Anxiety	36.53 (7.95)	37.11 (6.85)	−0.43	0.67	0.07

Note: TOM = Theory of Mind, *ADOS* = Autism Diagnostic Observation Schedule, *RRB* = Restricted, Repetitive Behavior, *CASS* = Contextual Assessment of Social Skills

* $p \leq 0.05$,

** $p \leq 0.01$,

*** $p \leq 0.005$

Table 2.

Cross Tabulation of Sex by Compensation Group based on ADOS and Theory of Mind (TOM)

SEX	HIGH COMP	LOW COMP	DEEP COMP	UNKNOWN	TOTAL
Male Count	19	40	38	17	114
Male %	16.7%	35.1%	33.3%	14.9%	100.0%
Female	9	7	16	13	45
Female %	20.0%	15.6%	35.6%	28.9%	100.0%
Total	28	47	54	30	159
Total %	17.6%	29.6%	34.0%	18.9%	100.0%

Note: Comp = Compensation.

Table 3.

Diagnostic and Social Communication Profiles of High and Low Compensation groups.

	High Comp (n = 28) M *(SD)*	Low Comp (n = 47) M *(SD)*	t	*p*	*d*
CASS					
Vocal Expression	4.89 (1.42)	4.00 (1.44)	2.56	0.01**	0.62
Gestures	2.57 (1.29)	2.28 (1.48)	0.87	0.39	0.21
Positive Affect	4.36 (1.61)	3.70 (1.37)	1.87	0.06	0.45
Overall Involvement	4.43 (1.17)	3.83 (1.40)	1.90	0.06	0.45
Ask Questions	2.36 (2.21)	3.81 (4.86)	−1.76	0.08	0.35
Topic Changes	3.00 (3.34)	2.74 (2.55)	0.37	0.71	0.09
Kinesic Arousal	3.82 (1.28)	3.70 (1.30)	0.39	0.70	0.09
Social Anxiety	4.71 (1.21)	3.74 (1.42)	3.01	0.004**	0.72
Quality of Rapport	4.36 (1.42)	3.64 (1.19)	2.36	0.02*	0.56
STAI-C					
State Anxiety	32.00 (6.76)	33.83 (8.23)	−0.99	0.32	0.24
Trait Anxiety	36.04 (8.77)	37.06 (7.87)	−0.52	0.60	0.12
Full Scale IQ	91.07 (15.33)	88.36 (18.25)	0.66	0.51	0.16
Verbal IQ	90.7 (13.0)	86.7 (17.6)	1.03	0.31	0.25
Performance IQ	92.9 (20.7)	91.1 (20.9)	0.35	0.72	0.08

Note: CASS = Contextual Assessment of Social Skills, Comp = Compensation, STAI-C = State Trait Anxiety Inventory for Children. For the CASS Social Anxiety lower scores reflect more anxiety and STAIC higher scores reflect more anxiety.

* $p \leq 0.05$,

** $p \leq 0.01$