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"Camouflaging" in Women with Autistic Traits: Measures, Mechanisms, and Mental Health Implications

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ABSTRACT

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Autistic traits are associated with frequent psychological distress and everyday functional challenges. Some individuals with autistic traits "camouflage" these traits during social interactions by effortfully engaging in "typical" social behaviors. Camouflaging seems to be especially common in autistic girls and women. Emerging evidence proposes a role for camouflaging behaviors in poorer mental health and daily functioning. Furthermore, camouflaging efforts may delay receipt of a proper diagnosis and access to appropriate mental health care. Despite their clinical significance, camouflaging efforts remain difficult to quantify, and the mechanisms and impacts of camouflaging are poorly understood. This study aimed to compare multiple methods of quantifying camouflaging, investigate potential mechanisms of camouflaging, and describe mental health implications of camouflaging behaviors.

The sample included 66 women (*M* age = 25:2 years, *SD* = 6:4; *M* IQ = 114, *SD* = 11) who reported social challenges and scored high on a measure of broad autistic traits. A minority (n = 22) had previously received an autism diagnosis. A majority reported significant anxiety, depression, or suicidality. Camouflaging was quantified using three methods: one self-report questionnaire (*CAT-Q*), and two discrepancy-based methods that contrasted presentation of autistic traits during the *ADOS-2* with measures of less-visible autistic traits (*AQ*, *TASIT-S*). Analyses showed that the discrepancy-based measures agreed with each other, but not with the self-report measure of camouflaging. Regression analyses showed camouflaging scores were poorly predicted by age, IQ, performance on executive functioning tasks, and self-reported social cognitive abilities. Regression models including clinician-rated and self-reported autistic traits showed that autistic traits on the *SRS-2*, and camouflaging efforts on the *CAT-Q*, modestly but significantly predicted psychological distress and functional challenges. Finally, clinician-administered and self-report diagnostic measures demonstrated only fair or poorer agreement with each other in this unique sample that includes women with elevated self-reported camouflaging.

Results emphasize the clinical significance of the camouflaging construct, which may predict mental health difficulties in individuals with autistic traits better than conventional autism measures. Quantifying camouflaging remains challenging as various proposed measures disagree with each other. Disagreement on diagnostic classification between measures underscores the importance of comprehensive, multi-method assessment of mental health in women who report difficulties fitting into social situations and who may be camouflaging significant autistic traits.

Keywords: autism, camouflaging, female, women, mental health, diagnosis

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Autism spectrum disorder is a neurodevelopmental condition defined by traits grouped into two domains: (a) atypical social communication (e.g., differences in making eye contact), and (b) restricted, repetitive patterns of behaviors (e.g., extreme distress at deviations from a routine; American Psychiatric Association, 2013). Underlying mechanisms for autism seem to arise from genetic variation and exposures to environmental risks which impact brain development (LaSalle, 2013; Lyall, Schmidt, & Hertz-Picciotto, 2014; Miles, 2011). However, there is currently no genetic test, blood test, or brain scan that can be used to diagnose autism, and the condition is assessed through the subjective evaluation of observable behaviors (Müller & Amaral, 2017).

The current global prevalence rate of ASD is estimated to be about one in 132 persons (Baxter et al., 2015). The prevalence in the United States is estimated to be one in every 59 children, and about four males are diagnosed with autism for every female (Baio et al., 2018). While clinic-based studies tend to show male-to-female ratios close to 4:1, population-based studies reveal ratios close to 3:1 (Loomes, Hull, & Mandy, 2017), with some population-based studies reporting ratios as low as 2.5:1 (Kim et al., 2011). The more equal ratio in non-referred samples suggests that many autistic females may be missed and never diagnosed (Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015)

Explanations of the Gender Gap in Autism Prevalence Rates

There are many theories about why autism affects more males then females, and about why affected females are sometimes missed for diagnosis. A variety of studies show that females

require more severe or a greater number of genetic abnormalities before they experience neurodevelopmental problems, a phenomenon referred to as the "female protective effect" (Gockley et al., 2015; Jacquemont et al., 2014; Robinson, Lichtenstein, Anckarsäter, Happé, & Ronald, 2013). Baron-Cohen and colleagues proposed the "extreme male brain" theory of autism, which is that the male brain is better at systematizing (analyzing and constructing systems) while the female brain is better at empathizing (understanding the thoughts and feelings of others), and autism occurs when an individual's brain becomes too male in its tendency towards systematizing (see Baron-Cohen et al., 2014). While there is evidence that autistic women are physiologically and psychologically more similar to men than are typically-developing women, the extreme male brain theory of autism remains controversial (Baron-Cohen et al., 2014; Nash & Grossi, 2007; Pohl, Cassidy, Auyeung, & Baron-Cohen, 2014).

One of the reasons autistic females may go unrecognized is that clinicians and parents are less likely to look for autistic traits in girls and women, and so less likely to notice them. In large population-based samples of children, girls with the same severity of parent-reported autism symptoms as boys are less likely to be referred for assessment and receive an autism diagnosis unless they have behavioral or intellectual problems in addition to autism-related concerns (Dworzynski, Ronald, Bolton, & Happé, 2012; Russell, Steer, & Golding, 2011). Even in families with at least one diagnosed, autistic child, female siblings with the same severity of parent-reported symptoms as male siblings are less likely to have an autism diagnosis (Constantino, Zhang, Frazier, Abbacchi, & Law, 2010). In extreme cases, families are sometimes erroneously told by health professionals that it is not possible for girls and women to have autism (Bargiela, Steward, & Mandy, 2016).

Another reason autistic females may go unrecognized is that girls and women are more likely to experience psychiatric conditions such as anxiety, affective, or eating disorders that may mask underlying autistic traits (Lai et al., 2015; Mandy & Tchanturia, 2015). Evidence of this claim includes the fact that women diagnosed with autism in adulthood are more likely than late-diagnosed men to have received a non-autism psychiatric diagnosis earlier in life (Geurts & Jansen, 2012). Furthermore, many existing diagnostic measures may have insufficient specificity to discriminate between autism and psychiatric conditions which are common in women, contributing to misdiagnosis (Cath, Ran, Smit, Balkom, & Comijs, 2008; South, Carr, Stephenson, Maisel, & Cox, 2017; van Steensel, Deutschman, & Bögels, 2013).

Growing evidence suggests that autism manifests differently in girls and women than it does in boys and men. Compared to autistic males, autistic girls and women may use more communicative gestures, have more typical speech patterns, and have fewer notable restricted and repetitive behaviors (Moseley, Hitchiner, & Kirkby, 2018; Parish-Morris et al., 2017; Rynkiewicz et al., 2016; Van Wijngaarden-Cremers et al., 2014). Table 1 from Lai et al. (2015) shows additional characteristics of autistic females that anecdotally distinguish them from autistic males. Since most autism research projects exclude or grossly under-sample autistic girls and women, there is a strong male bias in the research literature (Philip et al., 2012). This bias may partly explain why autistic girls and women go undiagnosed because current diagnostic assessment tools were designed to be maximally sensitive to the male presentation of autism, and they tend to be less sensitive and specific for females (Gould, 2017; Halladay et al., 2015; Lai et al., 2015). For example, interpretation of the widely-used *Autism Diagnostic Observation Schedule, Second Edition* (*ADOS-2*; Lord et al., 2012) relies on diagnostic cut-offs developed using a majority-male sample, and the measure is less sensitive for cognitively unimpaired

adolescent and adult females than males (Langmann, Becker, Poustka, Becker, & Kamp-Becker, 2017). Examining guidelines to inform the development of diagnostic tools that are sensitive and specific to female profiles of autistic traits is an active and urgent area of research (Gould, 2017; Halladay et al., 2015; Lai et al., 2015).

Table 1: *Anecdotal Descriptions of Behavioral Sex Differences in Autism*

Domain	Characteristics More Often Present in Females Than in Males
Social Interaction	Greater awareness of expectation for social interaction Desire to interact with others Passivity (a "loner"), often perceived as "just being shy" Tendency to "camouflage" difficulties by masking and/or developing strategies to appear more typical One or few close friendships Tendency to be "mothered" in a peer group in primary school, but often bullied in secondary school
Communication	More typical linguistic abilities developmentally Increased imagination (fantasizes and escapes into fiction and pretend play, but is prone to being nonreciprocal, scripted, and overly controlled)
Restricted, Repetitive Patterns of Behavior, Interests, or Activities	Restricted interests tend to involve people/animals rather than objects/things (e.g., animals, soap operas, celebrities, pop music, fashion, horses, pets, and literature) which may be less recognized as related to autism
Other	Tendency to be perfectionistic, very determined Tendency to be controlling (in play with peers) High (passive) demand avoidance Tendency to have episodes of eating problems

Note. Adapted from "Sex/gender differences and autism: Setting the scene for future research," by Lai, M.-C., Lombardo, M. V., Auyeung, B., Chakrabarti, B., & Baron-Cohen, S., 2015, *Journal of the American Academy of Child & Adolescent Psychiatry, 54*(1), 11–24. Licensed under Creative Commons (CC BY 3.0).

Camouflaging Behaviors in Girls and Women

Contributing to the challenge of appropriate assessment, autistic girls and women report that they often consciously attempt to hide or "camouflage" their autistic traits (Bargiela et al., 2016; Tierney, Burns, & Kilbey, 2016). Camouflaging may involve suppressing autistic behaviors ("masking") or effortfully engaging in more typical behavior ("compensating"; Hull et

al., 2017). Such strategies to appear more typical may range from avoiding talking too much about a favorite topic to practicing looking at a conversation partner's facial expressions before responding. An autistic woman who successfully camouflages and presents as socially competent may not be referred for clinical assessment, just as a depressed patient who presents with a smile may not be referred for treatment. Both masking and compensating fit into the general construct of compensation, defined as "improved behavioral presentation…despite persisting core [challenges]" (Livingston & Happé, 2017). I use the term "camouflaging" instead of "compensating" because it reflects concern that girls and women are being missed and not receiving a proper diagnosis that has the potential to unlock a variety of helpful supports and interventions (Jones, Goddard, Hill, Henry, & Crane, 2014).

Camouflaging is not unique to females, yet awareness of social difficulties and camouflaging seem to be especially common in autistic girls and women (e.g., Cassidy, Bradley, Shaw, & Baron-Cohen, 2018). This may be because, compared to autistic boys and men, on average, autistic females have more typical language and social skills which theoretically facilitate camouflaging (Head, McGillivray, & Stokes, 2014; Lai et al., 2011, 2016; Solomon, Miller, Taylor, Hinshaw, & Carter, 2012). Camouflaging may partly explain why the sex ratio is more equal in samples of autistic individuals with intellectual disability, since females with cognitive challenges are less able to camouflage (Fombonne, Quirke, & Hagen, 2011; Wing, 1981). Camouflaging may also partly explain why females are diagnosed with autism later than their male counterparts, as social challenges may only outstrip camouflaging abilities later in life (Giarelli et al., 2010).

Camouflaging and Mental Health

In addition to impacting the diagnostic process, camouflaging behaviors may have significant implications for mental health. Regardless of whether an autistic individual engages in camouflaging or not, autism is associated with increased risk for additional psychiatric concerns across the lifespan. The *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (*DSM-5*) notes that about 70% of autistic individuals receive at least one additional diagnosis, and about 40% receive at least two (American Psychiatric Association, 2013). Especially common co-occurring conditions include anxiety, attention-deficit/hyperactivity, and affective disorders (Leitner, 2014; Lever & Geurts, 2016; Nylander, Axmon, Björne, Ahlström, & Gillberg, 2018; Stewart, Barnard, Pearson, Hasan, & O'Brien, 2006; White, Oswald, Ollendick, & Scahill, 2009). Even mild, subclinical autistic traits (i.e., traits from the broader autism phenotype; Piven, Palmer, Jacobi, Childress, & Arndt, 1997) are associated with increased prevalence of psychiatric concerns (e.g., Cassidy, Bradley, Shaw, & Baron-Cohen, 2018). For example, the broader autism phenotype is associated with mood concerns in adolescence, adulthood, and older adulthood (Ingersoll & Hambrick, 2011; Nylander et al., 2018; Pine, Guyer, Goldwin, Towbin, & Leibenluft, 2008). Of course, individuals with autistic traits may experience psychiatric concerns that are unrelated to those traits (Bolton, Pickles, Murphy, & Rutter, 1998; Piven & Palmer, 1999), and the full relationship between autistic traits and mental health concerns remain unclear.

Multiple factors may explain why autistic individuals experience mental health concerns more often than their neurotypical peers. There may be overlap in the genetic patterns that contribute to autistic traits and emotional distress (Gadow, Roohi, DeVincent, & Hatchwell, 2008; Kluck, Poustka, Benner, Lesch, & Poustka, 1997). Expression of such genetic patterns

may be associated with patterns of brain functioning which are shared between autism and other conditions (Insel et al., 2010; Menon, 2011). Such shared patterns may involve basic functions such as attentional biases shared between autism and anxiety, or higher-order functions such as cognitive rigidity in both autism and anorexia (Herrington et al., 2017; Oldershaw, Treasure, Hambrook, Tchanturia, & Schmidt, 2011; Schultz & Searleman, 2002).

Difficulty fitting in with neurotypical social situations may also contribute to mental health concerns. Such difficulty can lead to autistic individuals experiencing reduced support in their social networks, which in turn increases the likelihood of psychiatric concerns (see Howlin & Magiati, 2017). While some autistic individuals state that they are unconcerned by such social challenges, many others are keenly aware of these challenges and feel different, misunderstood, or lonely (Bargiela et al., 2016; Capps, Sigman, & Yirmiya, 1995; Gotham, Bishop, Brunwasser, & Lord, 2014). This may be especially true for undiagnosed, potentially camouflaged autistic individuals who are more likely to attribute social challenges to personal traits rather than to traits shared with other autistic people, with the former often leading to poor self-concept and feelings of isolation, and the latter potentially leading to self-awareness and a sense of community (Hickey, Crabtree, & Stott, 2018; Hurlbutt & Chalmers, 2002; Kanfiszer, Davies, & Collins, 2017; Leedham, Thompson, Smith, & Freeth, 2019; Portway & Johnson, 2005; Webster & Garvis, 2017).

Adaptive camouflaging efforts may help autistic people fit in and avoid a range of social stressors associated with mental health concerns. For example, an individual who consciously avoids talking excessively about topics of special interest may be more likely to make and keep friends. As another example, an individual who effortfully makes eye contact and carefully evaluates a conversation partners' facial expressions may be more likely to interview well and

obtain employment. Camouflaging may also produce less-tangible benefits. One qualitative study quoted an autistic women who shared that she feels camouflaging is rewarding for her because she "[shows people] that autistic people can have people skills and be good role models" (Hull et al., 2017). The numerous short- and long-term benefits of camouflaging efforts reinforce the behavior and make future efforts more likely.

Despite the advantages of successful camouflaging, camouflaging efforts may also lead to poor mental health. Individuals who camouflage often report that they experience low self-esteem, stress, exhaustion, anxiety, and depression (Cage & Troxell-Whitman, 2019; Milner, McIntosh, Colvert, & Happé, 2019). The *DSM-5* notes that autistic adults "who have developed compensation [or camouflaging] strategies for some social challenges" may experience anxiety or fatigue, especially in "novel or unsupported situations" (American Psychiatric Association, 2013). Since camouflaging efforts seem more common in girls and women, camouflaging may partly explain why autistic females show higher high rates of anxiety and depression than autistic males (Mandy et al., 2012; Oswald et al., 2016; Solomon et al., 2012), mirroring patterns in the general population that show internalizing disorders are more prevalent in girls and women (Kessler et al., 2005).

Investigations of the relationship between camouflaging and internalizing disorders in autistic women have yielded mixed results. One study of combined autistic men and women (N = 306) showed significant associations between self-reported camouflaging and symptoms of depression and anxiety (Hull et al., 2019). Another study of autistic men and women (N = 60) showed that camouflaging was related to symptoms of depression (r = 0.3), but not anxiety, and was unrelated to both in the female subsample (n = 30; Lai et al., 2016). Cassidy, Bradley, Shaw, & Baron-Cohen (2018) have shown that, for autistic men and women (N = 164) who were first

diagnosed in adulthood, self-reported camouflaging efforts were predictive of suicidality even after controlling for sex, depression, anxiety, age, and employment. This is important because, in contrast to general population trends showing women are less likely than men to die by suicide (Hedegaard, Curtin, & Warner, 2018), autistic women are just as likely, if not more likely, to die by suicide than autistic men (Hirvikoski et al., 2016; Kirby et al., 2019).

Beyond contributing to psychological distress, camouflaging efforts may contribute to challenges in functioning well at work, at home, and in other contexts. A majority of autistic individuals with average intellectual functioning may struggle to secure or maintain full-time employment and so rely on extensive support from family (Engström, Ekström, & Emilsson, 2003; Howlin, 2000). Autistic women may have worse functional outcomes than men, although the impact of sex and other factors on functional challenges in adulthood is not well understood (Howlin & Magiati, 2017; Kirby, Baranek, & Fox, 2016; Taylor, Henninger, & Mailick, 2015). To my knowledge, no study has directly investigated the relationship between camouflaging in women and everyday functional challenges.

Attempts to Quantify Camouflaging

The clinical importance of camouflaging has led multiple researchers to attempt to quantify the construct, yet – as its name suggests – camouflaging is inherently difficult to detect and measure. In a recent article, Hull et al. (2019) categorized attempts at quantifying camouflaging to date as either *discrepancy* approaches or *observational/reflective* approaches. Discrepancy approaches involve contrasting "internal autistic status" (i.e., performance on a measure of internal autistic traits, such as a measure of social cognition) with "autistic presentation" (i.e., performance on a measure of how autistic the person appears, such as a measure of social behavior). The discrepancy approach was advocated by Livingston & Happé

(2017) and attempted by Lai et al. (2016) who measured internal autistic status using the *Autism Spectrum Quotient* (*AQ*; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) and the *Reading the Mind in the Eyes Test* (*RMET*; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001), and measured external autistic presentation using the *Autism Diagnostic Observation Schedule* (*ADOS*). Observational/reflective approaches involve observing camouflaging behaviors or asking the individual to reflect and report on camouflaging behaviors. Examples of such approaches include observing whether autistic girls seem to camouflage by behaving similarly to typical peers on the playground (Dean, Harwood, & Kasari, 2016); completing in-depth interviews with autistic girls and women (e.g., Hull et al., 2017; Milner et al., 2019); administering custom self-report measures of camouflaging (Cassidy, Bradley, Shaw, & Baron-Cohen, 2018); and administering the newly-developed self-report *Camouflaging Autistic Traits Questionnaire* (*CAT-Q*; Cage & Troxell-Whitman, 2019; Hull et al., 2019).

Each approach has its own strengths and weaknesses. Hull et al. (2019) identified the primary strength of the discrepancy approach as its conceptual rigor, since it attempts to confirm the presence of the trait being camouflaged, in addition to measuring how well the trait is hidden. However, Hull et al. (2019) questioned the practicality and even the possibility of quantifying internal autistic status since there is no single, universal autistic trait; and they noted that the discrepancy approach is unable to capture the individual's unsuccessful camouflaging efforts, which may impact mental health more than successful ones. The specific discrepancy approach used by Lai et al. (2016) arguably is limited because the *AQ* (a self-report questionnaire) and *RMET* (a task requiring participants to make complex emotional inferences from black-and-white photographs of the eye region) both measure internal autistic status in a manner that may not always correspond to real-life social interaction (Henry, Cowan, Lee, & Sachdev, 2015). Hull

et al. (2019) described the primary strength of the observational approaches as not depending on any measure of an internal autistic state, and their weaknesses as being constrained by what the observer recognizes as camouflaging and still being unable to capture unsuccessful camouflaging efforts. Finally, Hull et al. (2019) noted the strength of reflective/self-report measures is that they have the potential to capture all camouflaging behaviors identified by the autistic individual, including unique or unsuccessful efforts. Weaknesses of the reflective/self-report approaches include that the autistic individual may struggle with alexithymia or poor self-insight and either over- or under- report their experience of camouflaging (Berthoz & Hill, 2005; Lombardo, Barnes, Wheelwright, & Baron-Cohen, 2007). Also, individuals may report many efforts to camouflage autistic traits even when they do not experience significant autistic traits. To capitalize on the strengths and avoid the weaknesses of each approach, Hull et al. (2019) recommend triangulating approaches to accurately measure such a complex construct (Thurmond, 2001). To my knowledge, no research group has yet attempted this by administering multiple types of camouflaging measures to the same sample.

Potential Mechanisms of Camouflaging

Just as it is currently unclear how best to quantify camouflaging, it is also unclear what abilities or skills allow some individuals to successfully camouflage their autistic traits. Greater understanding of the mechanisms of camouflaging potentially will allow clinicians to predict who may is likely to engage in adaptive camouflaging, and who is likely to engage in unsuccessful, detrimental camouflaging. Researchers have proposed IQ, attention, processing speed, verbal ability, executive functioning skills, and neural responses as potential mechanisms (Lai et al., 2016; Livingston & Happé, 2017). Executive functioning skills may be especially key in scanning the social environment, inhibiting autistic social responses, and switching to learned,

typical social responses. Social cognitive abilities may also be key. Social cognitive challenges such as atypical emotion processing and poor theory of mind are common in autistic individuals (Boucher, 2012; Harms, Martin, & Wallace, 2010; Humphreys, Minshew, Leonard, & Behrmann, 2007; Law Smith, Montagne, Perrett, Gill, & Gallagher, 2010; Mathersul, McDonald, & Rushby, 2013; Montgomery et al., 2016). Autistic individuals with more typical social cognition may be more aware of their atypical social behavior and more able to camouflage it. However, the relationship between potential mechanisms and camouflaging is likely complicated because, while autistic individuals with unimpaired intellectual and executive functioning and fewer social cognitive challenges may be most *able* to camouflage, individuals with cognitive and social challenges may be most *motivated* to camouflage these very challenges.

To date, only two published studies have explored underlying mechanisms of camouflaging. Lai et al. (2016) reported that a discrepancy-based measure of camouflaging was associated with executive functioning abilities (*d'* from Go/No-Go task), but not IQ. A second study from the same group showed that camouflaging in autistic women (n = 28) but not men (n = 29) was positively associated with ventromedial prefrontal cortex activation during a functional magnetic resonance imaging (fMRI) task that asked participants to think about their personal characteristics (Lai et al., 2018). The authors interpreted this finding as indicating that camouflaging in autistic women may be associated with social functions of the brain which may be unique to women.

Study Aims

In response to calls to explore camouflaging and related constructs in broad samples that include undiagnosed (potentially camouflaged) women (see Halladay et al., 2015; Livingston & Happé, 2017), the study team recruited a sample of women who self-reported significant social

challenges in everyday life and who subsequently scored high on measures of autistic traits. Most women recruited for this study did not have a previous autism diagnosis and did not meet current diagnostic criteria for autism. Some of these women may represent an autism diagnostic "gray zone" where significant autistic traits are present, yet diagnostic criteria do not fit their pattern of symptoms well. For other participants, social phobia, depression, or other mental health concerns may have contributed more to their social challenges than their autistic traits, and they may represent a group with subclinical autistic traits. Given the difficulty in attributing causality to social challenges, the desire to study a broad range of camouflaging behavior, and the high rates of co-occurring mental health challenges in autistic women, we included women in this latter group who reported elevated yet subclinical autistic traits.

This study had five major aims:

Aim 1. To examine the strength of association among three different measures of camouflaging (listed below) and assess agreement between them in identifying participants with elevated (above-median) levels of camouflaging behaviors.

a. the *Camouflaging Autistic Traits Questionnaire (CAT-Q)*, a newly validated self-report measure of camouflaging
b. a novel discrepancy measure of camouflaging that contrasts *ADOS* scores with performance on a video-vignette-based measure of social cognition
c. the discrepancy measure proposed by Lai et al. (2016) that contrasts *ADOS* with *AQ* scores.

Aim 2. To investigate potential predictors of camouflaging scores, including IQ, executive functioning skills, and self-reported social cognitive ability.

Aim 3. To characterize the nature of psychological distress, suicidality, and functional challenges in this unique sample.

Aim 4. To model the relationships between these mental health concerns, autistic traits, and *CAT-Q* camouflaging scores that, unlike discrepancy-based scores, capture unsuccessful camouflaging efforts which may impact mental health more than successful ones (Hull et al., 2019).

Aim 5. To examine agreement between diagnostic classifications made using various autism symptom measures.

Hypotheses

Hypothesis 1. Due to significant methodological differences, discrepancy-based and self-report camouflaging scores will show only weak association and poor agreement.

Hypothesis 2. Executive functioning abilities – specifically inhibition and switching abilities – will predict camouflaging scores above and beyond IQ, age, and social cognitive abilities.

Hypothesis 3. Similar to previously reported samples of autistic women, a majority of the present sample of women with autistic traits will report clinically significant psychological distress. They will also report clinically significant functional challenges.

Hypothesis 4. Self-reported *CAT-Q* camouflaging scores will significantly predict distress and functional challenges even after accounting for severity and self-awareness of autistic traits.

Hypothesis 5. Based on previous studies showing poor sensitivity and specificity for females, autism diagnostic measures will show poor agreement on diagnostic classification in this sample of women with autistic traits.

General Methods

Different samples were used to achieve the study aims. For the sake of clarity, the study will be broken into two, with the first study using a sample to explore measures and mechanisms (Aims 1 - 2), and the second using a separate sample to explore camouflaging's mental health implications (Aims 3 - 5). Shared methods and procedures are described below.

Measures

Screening measure. The *Broad Autism Phenotype Questionnaire* (*BAPQ*; Hurley, Losh, Parlier, Reznick, & Piven, 2007) is a 36-item self-report measure of autism-related traits (e.g., "I like being around other people") with high inter-item reliability (Cronbach's α = 0.95). In the Hurley et al. validation sample (n = 150 women), using a total score cutoff of 3.25 yielded 75% sensitivity and 87% specificity for autistic personality traits in female relatives of autistic individuals. A more recent study (n = 18 women) used a lower total score cutoff of 3.17 and reported 33% sensitivity and 100% specificity for women (Sasson, Lam, & Childress, 2013). In order to include all potential participants with significant autistic traits, I valued sensitivity over specificity and used a liberal cutoff of 3.0.

Self-reported camouflaging. The *Camouflaging Autistic Traits Questionnaire* (*CAT-Q;* Hull et al., 2019) total score was used as a self-report measure of camouflaging. The *CAT-Q* is a 25-item measure of social camouflaging behaviors – strategies used to compensate for or mask autistic traits to facilitate social assimilation (e.g., "When I am interacting with someone, I deliberately copy their body language or facial expressions"). Response options are presented in a seven-point, symmetric, agree-disagree Likert scale. The *CAT-Q* was developed for online administration and the validation sample included 354 autistic and 478 non-autistic adults. Internal consistency (α = 0.94) and test-retest reliability (r = 0.77) are acceptable. Higher scores

indicate more camouflaging.

Clinician-rated autistic traits. The *Autism Diagnostic Observation Schedule, Second Edition, Module 4* (*ADOS-2*; Lord et al., 2012) is widely recognized as a valid and reliable diagnostic instrument for adults with autism spectrum disorder (Gotham, Risi, Pickles, & Lord, 2006). The measure involves a semi-structured interaction session lasting about one hour that allows an examiner to rate the presence of various autistic traits in the participant. Ratings are then entered into an algorithm that produces a total score which can be compared to an empirically derived diagnostic cutoff. I used the revised 15-item scoring algorithm because, compared to the original algorithm, it shows superior sensitivity (90.5%) and specificity (82.2%; Hus & Lord, 2014) in adults. All examiners were *ADOS-2* trained and were supervised by clinicians who have attained *ADOS-2* research reliability. *ADOS-2* administrations were video recorded and eighty-six percent were scored by a second clinician. Raters achieved mean inter-rater reliability of 0.87.

Self-reported autistic traits. The *Social Responsiveness Scale, Second Edition, Adult Self-Report* (*SRS-2*; Constantino, 2012) is a 65-item self-report measure of the presence of autistic traits over the past six months. Each item is rated on a four-point Likert scale ("not true" to "almost always true"). The measure produces a total score, as well as two *DSM-5*-based index scores: Social Communication, and Restricted Interests and Repetitive Behavior. Test-retest correlations range from 0.88 - 0.95; inter-rater reliability coefficients range from 0.61 - 0.92 (Bruni, 2014).

The *Autism Quotient* (*AQ*; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) is a 50-item self-report questionnaire that assesses personal traits related to autism, such as social skills, attention switching, attention to detail, communication, and imagination. For

example, one item reads, “I know how to tell if someone listening to me is getting bored.” Items are rated on a four-point, agree-disagree Likert scale. The authors reported good test-retest and inter-rater reliability and recommended a total score of 32 as a diagnostic cutoff.

IQ. The *Wechsler Abbreviated Scale of Intelligence, Second Edition* (*WASI-II*; Wechsler & Hsiao-Pin, 2011) is a brief, valid measure of IQ. Participants completed the Vocabulary and Matrix Reasoning subtests and I calculated two-scale full-scale IQ (FSIQ-2). The *WASI-II* has test-retest reliability of 0.88 for FSIQ-2 in adults.

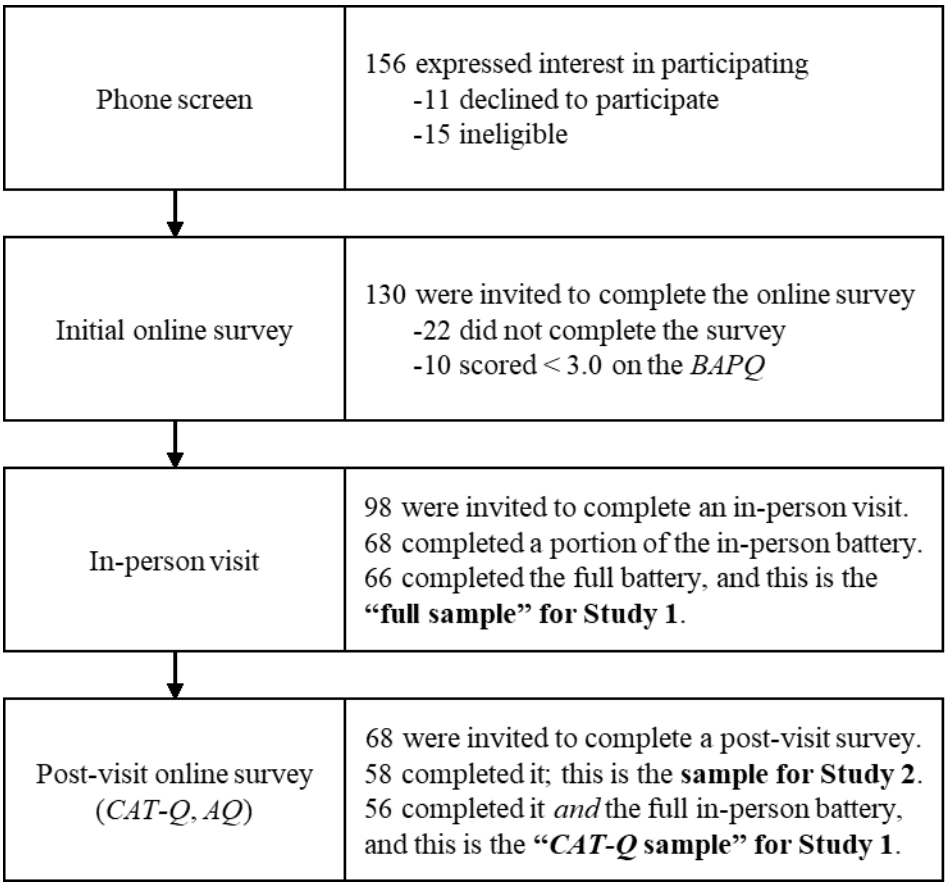
Procedure

All study procedures were approved by the university Institutional Review Board (IRB). Written consent was obtained for all participants in accord with the Declaration of Helsinki. This project was part of a larger series of studies that included self-report and parent-report measures not reported here. A complete list of administered materials is in Appendix A.

Women participants were recruited through university-based and private mental health clinics, from social media, and from an intense residential support program for autistic young adults. The recruitment flyer for the study read, “In social situations, do you often find yourself confused, anxious, or exhausted?” (see Appendix B). An existing autism diagnosis was not required for participation. Women who expressed interest in participation and who reported social challenges (i.e., confusion, anxiety, or exhaustion in social situations) in a brief phone interview were invited to complete self-report questionnaires using the Qualtrics online survey platform (Qualtrics, Inc., Provo, Utah). These initial self-report questionnaires included the *BAPQ*, *SRS-2*, and a custom questionnaire regarding demographic information, treatment history, and additional topics related to health and social history. Women with a *BAPQ* total score > 3.0 indicating the presence of autistic traits were invited to an on-campus lab to complete an in-

person assessment involving the *WASI-II*, *ADOS-2*, and other behavioral measures. Following the assessment, researchers invited participants to complete the *CAT-Q* and *AQ* through Qualtrics. See Figure 1 for a summary of the sample formation process. Participants were compensated $10/hour for their participation in both online and in-person portions.

Figure 1: *Summary of the Process of Sample Formation*



Note. *BAPQ*: *Broader Autism Phenotype Questionnaire*. *AQ*: *Autism Quotient*. *CAT-Q*: *Camouflaging Autistic Traits Questionnaire*. The study is ongoing. Of the thirty women who completed the initial online survey but not the in-person visit, about half are in communication with the study team to schedule or complete the visit. The other half have not responded to outreach or have moved out of state. Of the two women who did not complete the full in-person battery of measures, one was unable to complete the Color-Word Interference task due to color blindness, and one did not complete IQ testing because the study team erroneously believed they had access to recent IQ data.

Data Analyses

Boxplots were used to identify outliers. Before analyses, extreme scores were Winsorized to 5th and 95th percentile values (Dixon & Yuen, 1974). Re-analysis of un-Winsorized data did not significantly change our findings. Statistical analyses were implemented using Stata version 15.1 (StataCorp, 2017).

Study 1: Measures and Mechanisms

Additional Measures

Social cognitive ability. *The Awareness of Social Inference Test, Short Version* (*TASIT-S*; Honan, McDonald, Sufani, Hine, & Kumfor, 2016) is considered one of the most ecologically valid assessments of social cognition because it assesses social cognitive abilities through forced-choice questions regarding social interactions between adult actors in realistic video clips (Henry et al., 2015). The test lasts approximately thirty minutes and involves three sections. The first section measures emotion recognition abilities. The second section involves making social inferences with items that assess cognitive, affective, and conative theory of mind – the ability that allows an individual to predict the thoughts, feelings, and intentions in another's mind. For example, after watching a video clip of a woman sarcastically telling a man he does not need to help her because he is reading a book, the examinee is asked multiple questions: "Does she think he should stop what he is doing and help her?," "Is she annoyed with him?," and "Is she trying to say it's OK if he doesn't help her?" The third section is similar to the second, except the participant is shown additional information which makes accurate social inferences easier. For example, the clip may show the examinee the contents of a box the actors are discussing, whereas in the second section the contents were concealed. Each section produces a total score. I analyzed scores from the second section as this is the most challenging section and most likely to

be sensitive to social cognitive difficulties.

Discrepancy-based camouflaging. In addition to quantifying camouflaging with the *CAT-Q* – a self-report, observational/reflective measure – I quantified camouflaging using two discrepancy-based methods. Both used methodology described in Lai et al. (2016) whereby putative measures of autistic traits (*TASIT-S* and *AQ*) and clinician-observed autistic presentation (*ADOS-2*) are mean-centered and scaled (divided by the maximum possible score). *TASIT-S* scores were inverted (*-1) so that scores on these measures could be interpreted similarly (high score indicates greater autistic traits). Then, centered and scaled *ADOS-2* scores were subtracted from each centered and scaled measure of internal autistic traits to generate two camouflaging indices: "Camouflaging (*TASIT - ADOS*)" and "Camouflaging (*AQ - ADOS*)." Higher scores on these indices indicate more camouflaging. As an extension of the methodology used by Lai and colleagues, I calculated *z*-scores for each measure using sample standard deviations and then followed the same inversion and subtraction procedure described above to calculate corollary *z*-score, discrepancy-based camouflaging indices.

Executive functioning. Participants completed two subtests of the *Delis-Kaplan Executive Functioning System* (D-KEFS; Delis, Kaplan, & Kramer, 2001): *Trail Making* which assesses visual scanning and switching, and *Color-Word Interference* (a variation of the Stroop task) which assesses inhibition of an overlearned response and flexibility. Each subtest involves multiple scorable tasks/conditions. I analyzed scores from the fourth task of each subtest as these tasks are the most challenging and so most likely to be sensitive to subtle executive functioning difficulties. Internal consistency is adequate for both subtests. However, similar to other complex neuropsychological executive functioning tasks, performance variability is such that test-retest

reliability is low for *Trail Making* and marginal to adequate for *Color-Word Interference* (Delis, Kramer, Kaplan, & Holdnack, 2004).

Participants

Sixty-six adult women completed all measures during the in-person assessment. These participants ranged in age from 18 to 42 years (M = 25.17, SD = 6.33) and IQ ranged from 89 to 140 (M = 114.26, SD = 10.76; see Table 2). Twenty-two participants (33%) had received a previous formal diagnosis of autism spectrum disorder (autism or Asperger syndrome), with most receiving a diagnosis in childhood or adolescence. Twenty-one participants (32%) scored above the diagnostic cutoff on *ADOS-2*. Most participants were Caucasian, working part time, single or divorced, and receiving ongoing mental health care (see Table 3). A subsample of fifty-six women completed the post-assessment Qualtrics survey (the "*CAT-Q* Sample").

Data Analyses

I calculated Pearson correlations to examine agreement between camouflaging measures. I also categorized each participant as above or below the sample median score for each camouflaging measure, and then used Cohen's kappa test to explore agreement in these classifications (McHugh, 2012).

I tested ordinary least-squares regression models of each camouflaging measure with age, IQ, executive functioning (*D-KEFS Trail Making* and *D-KEFS Color-Word Interference*), and self-reported social cognitive difficulties (*SRS-2* Social Communication Index) as potential predictor variables. For these regression analyses, one case with an outlying (> 2 *SD* below the mean) *SRS-2* Social Communication Index score was removed. Before entering predictors into each model, I first generated scatterplots to confirm linearity. Given the small amount of quantitative research on these constructs, I completed simultaneous (versus hierarchical)

regressions. Following model estimations, Shapiro-Wilk tests showed normality in the distributions of regression residuals (Thode, 2002), scatterplots of residuals against predicted/fitted variables did not show notable heteroscedasticity, and collinearity was not problematic as the variance inflation factors (VIF) for all variables was < 2 (O'Brien, 2007).

Table 2: *Study 1 Participant Characteristics*

	Full Sample (N = 66)			*CAT-Q* Sample (n = 56)		
	M	(*SD*)	Range	*M*	(*SD*)	Range
Age in years	25.17	(6.33)	18 - 42	25.17	(6.17)	18 - 42
FSIQ-2	114.26	(10.76)	89 - 140	114.46	(11.33)	89 - 140
ADOS-2 total score	5.94	(5.22)	0 - 18	6.11	(5.45)	0 - 18
Self-reported autistic traits						
SRS-2 raw total score	92.02	(24.52)	33 - 156	89.80	(21.88)	33 - 139
SRS-2 raw SCI score	74.55	(18.69)	28 - 128	73.21	(16.90)	28 - 110
AQ total score	—	—	—	28.48	(6.62)	13 - 43
BAPQ total score	3.93	(0.50)	3.08 - 5.28	3.89	(0.46)	3.08 - 5.28
CAT-Q total score	—	—	—	4.72	(0.91)	2.32 - 6.28
TASIT-S Part 2 total score	29.97	(3.78)	21 - 36	29.88	(3.80)	21 - 36
Executive functioning						
D-KEFS Trails	10.83	(2.36)	1 - 15	10.89	(2.39)	1 -15
D-KEFS Color-Word Interference	10.18	(2.90)	1 - 15	10.27	(2.98)	1 - 15

Note. FSIQ-2: Two-scale full-scale IQ. *ADOS-2: Autism Diagnostic Observation Schedule, Second Edition. SRS-2: Social Responsiveness Scale, Second Edition.* SCI: Social Communication Index. *AQ: Autism Quotient*. *BAPQ: Broader Autism Phenotype Questionnaire*. *CAT-Q: Camouflaging Autistic Traits Questionnaire*. *TASIT-S: The Awareness of Social Inference Test, Short Version*. *D-KEFS: Delis-Kaplan Executive Functioning System.*

Table 3: *Study 1 Participant Demographics*

	Full Sample (N = 66)		*CAT-Q* Sample (n = 56)	
	n	(%)	*n*	(%)
Previous autism diagnosis				
Diagnosed in childhood/adolescence	15	(22.7)	13	(23.2)
Diagnosed in adulthood	7	(10.6)	4	(7.1)
Mental health treatment				
Previous psychotherapy	51	(77.3)	42	(75.0)
Previous medication	49	(74.2)	41	(73.2)
Ongoing psychotherapy	27	(40.9)	25	(44.6)
Ongoing medication	37	(56.1)	32	(57.1)
Educational background				
Some high school	2	-3.0	2	(3.6)
High school diploma or GED	4	(6.1)	4	(7.1)
Associate's degree	6	(9.1)	5	(8.9)
College student	32	(48.5)	26	(46.4)
Bachelor's degree	16	(24.2)	14	(25.0)
Graduate degree	6	(9.1)	5	(8.9)
Relationship status				
Single	38	(57.6)	35	(62.5)
In a dating relationship	12	(18.2)	7	(12.5)
Married or engaged	13	(19.7)	12	(21.4)
Divorced or separated	3	(4.5)	2	(3.6)
Employment status				
Unemployed	17	(25.8)	13	(23.2)
Part-time work	44	(66.7)	38	(67.9)
Full-time work	5	(7.6)	5	(8.9)
Socioeconomic background				
At least one parent earned a bachelor's degree	56	(84.8)	48	(85.7)
At least one parent earned an advanced degree	38	(57.6)	32	(57.1)
Both parents earned bachelor's degrees	30	(45.5)	24	(42.9)
Both parents earned advanced degrees	6	(9.1)	5	(8.9)
Ethnicity				
Hispanic or Latino	5	(7.6)	4	(7.1)
Not Hispanic or Latino	61	(92.4)	52	(92.9)
Race				
Asian	1	(1.5)	1	(1.8)
Black or African-American	1	(1.5)	1	(1.8)
White	63	(95.5)	53	(94.6)
More than one race	1	(1.5)	1	(1.8)

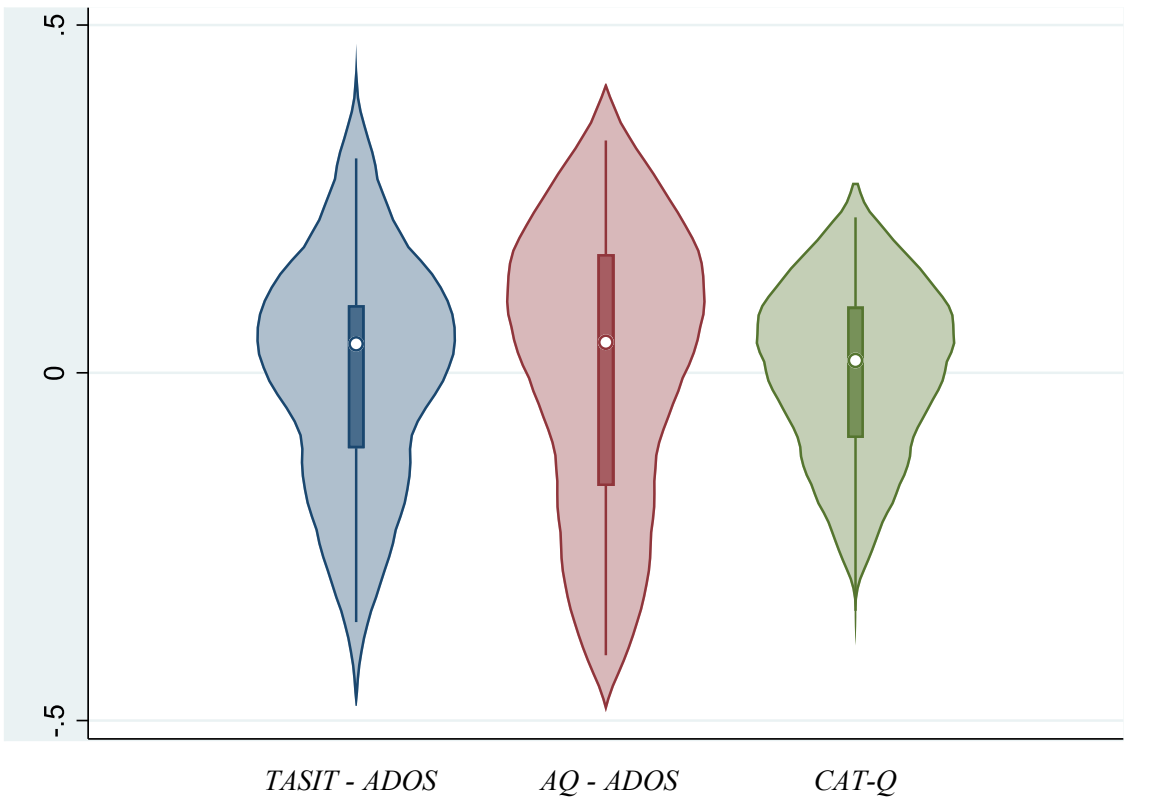
Power Analyses

Lai et al. (2016) reported a moderate correlation ($r = 0.43$; $R^2 = 0.18$) between a discrepancy-based (*ADOS* - *AQ*) camouflaging score and a measure of executive functioning ability. With a sample size of 66, a fixed-model linear multiple regression with five predictors has sufficient power ($\beta = 0.80$) to detect an R^2 deviation from zero of medium magnitude ($f^2 = 0.21$; $R^2 = 0.18$), and a sample of 56 likewise has power to detect a deviation of medium magnitude ($f^2 = 0.26$; $R^2 = 0.21$). These power analyses were conducted using G*Power version 3.1.9.2 (Faul, Erdfelder, Buchner, & Lang, 2009). Given the proportions of classifications for above-median camouflaging in our sample (*TASIT – ADOS*: 0.50; *AQ – ADOS*: 0.50; *CAT-Q*: 0.48) and $\alpha = 0.05$, a sample size of thirty-seven was needed to achieve power of 0.8 to detect moderate agreement between measures (Cohen's $\kappa > 0.4$; Cantor, 1996).

Results

In the present sample of women with significant self-reported autistic traits, slightly more than half ($n = 38$; 58%) had positive *TASIT-ADOS* discrepancy camouflaging scores (discrepancy score > 0), with 9 participants (14%) scoring > 1 *SD* above the mean, and 12 (18%) scoring > 1 *SD* below the mean. The *AQ-ADOS* discrepancy scores likewise showed that about half ($n = 33$; 59% of the smaller sample) had positive scores, with 9 participants (16%) scoring > 1 *SD* above the mean, and 12 (21%) scoring > 1 *SD* below the mean. On the *CAT-Q*, about half ($n = 30$; 54%) reported camouflaging to a degree above the reported mean of the autistic sample used to validate the measure (Hull et al., 2019), 9 (16%) scored > 1 *SD* above the sample mean, and 10 (18%) scored > 1 *SD* below the sample mean. For ease of comparison, I mean-centered *CAT-Q* scores and scaled them by the maximum possible total score before plotting them (see Figure 2).

Figure 2: *Violin Plots of Camouflaging Scores*



Note. TASIT: The Awareness of Social Inference Test, Short Version. ADOS-2: Autism Diagnostic Observation Schedule, Second Edition. AQ: Autism Quotient. CAT-Q: Camouflaging Autistic Traits Questionnaire. Discrepancy-based camouflaging measures (*TASIT - ADOS*, *AQ - ADOS*) reflect a contrast between scaled (i.e., divided by the maximum possible score) and mean-centered *TASIT-S* or *AQ* scores, and scaled and mean-centered *ADOS-2* scores. Due to the scaling process, each component score is like a percentage of the possible autistic traits assessed by the instrument. Discrepancy-based measures are difficult to interpret; however, positive (> 0) scores indicate possible camouflaging. On both discrepancy measures, roughly half of participants scored on either side of this discrepancy cut score. *CAT-Q* scores presented here have been scaled by the total possible *CAT-Q* score and centered on the sample mean.

Agreement between camouflaging scores. The two discrepancy measures were highly correlated with each other ($r = 0.71$, $p < .001$), but neither was associated with the *CAT-Q* (*p*s > 0.33). Cohen's Kappa analyses showed that the discrepancy measures moderately agreed in classifying participants as above-median camouflagers ($\kappa = 0.57$), but the *CAT-Q* and discrepancy measures agreed only slightly ($\kappa < 0.2$; Table 4; Landis & Koch, 1977). Analyses with discrepancy-based camouflaging scores calculated using *z*-scores revealed similar findings:

the discrepancy measures were highly correlated ($r = 0.52$, $p < .001$) and they moderately agreed ($\kappa = 0.50$, $p < .001$), while the *CAT-Q* did not significantly associate or agree with the discrepancy measures (ps > 0.21). A post-hoc Pearson correlation analysis revealed that a correlation between *TASIT-S* Part 2 total scores and *AQ* total scores approached significance ($r = -0.26$, $p = 0.05$), while *CAT-Q* scores were unassociated with *TASIT-S* Part 2 total ($r = 0.05$, $p = 0.73$) and *AQ* scores ($r = 0.21$, $p = 0.11$).

Table 4: *Cohen's Kappa Agreement Between Camouflaging Scores*

	Expected Agreement	Agreement	κ	*SE*	*z*	*p*	(95% CI)
CAT-Q & Camouflaging (*TASIT - ADOS*)	50.13%	55.36%	0.10	0.13	0.79	0.22	(-0.16, 0.37)
CAT-Q & Camouflaging (*AQ - ADOS*)	50.00%	58.93%	0.18	0.13	1.34	0.09	(-0.08, 0.44)
Camouflaging (*TASIT - ADOS*) & Camouflaging (*AQ - ADOS*)	50.00%	78.57%	0.57	0.13	4.29	< 0.001	(0.36, 0.79)

Note. CAT-Q: Camouflaging Autistic Traits Questionnaire. TASIT: The Awareness of Social Inference Test, Short Version. ADOS-2: Autism Diagnostic Observation Schedule, Second Edition. AQ: Autism Quotient.

Potential mechanisms of camouflaging. Only one measure of camouflaging was significantly predicted by age, IQ, executive functioning scores, or the *SRS-2* Social Communication Index. Specifically, the regression model of *AQ - ADOS* camouflaging scores was statistically significant, $F(5, 49) = 3.28$, $p = 0.01$, accounting for 17% of the variance in these scores. The model showed that *SRS-2* Social Communication Index scores significantly predicted *AQ - ADOS* camouflaging scores ($\beta = 0.28$, $p = .03$), while *D-KEFS* Color-Word Interference scores approached significance as a predictor ($\beta = 0.28$, $p = .08$; see Table 5).The regression model of *TASIT - ADOS* camouflaging scores was also statistically significant, $F(5, 59) = 2.52$, $p = 0.04$. The entered predictors did not significantly predict *TASIT - ADOS* camouflaging scores, although age approached significance ($\beta = -0.24$, $p = .06$). The overall model of *CAT-Q* scores was insignificant, $F(5, 49) = 0.51$, $p = 0.77$. Regression analyses completed with *z*-score-based camouflaging scores confirmed *SRS-2* Social Communication Index scores as a significant predictor of *AQ - ADOS* camouflaging scores ($\beta = 0.34$, $p = .01$). Other predictors did not approach significance in models of *z*-score-based scores.

Table 5: *Linear Regression Models of Camouflaging Scores*

Criterion	Predictor	*t*	*p*	*B*	*SE B*	*β*	*F*	*df*	*p*	R^2	R^2_{adj}
Camouflaging (*TASIT - ADOS*)							2.52	(5, 59)	0.04	0.18	0.11
	Age	-1.89	.06	-.007	.004	-.24					
	FSIQ-2	-1.13	.26	-.002	.002	-.15					
	D-KEFS Trail Making	1.36	.18	.018	.013	.20					
	D-KEFS Color-Word Interference	.97	.34	.010	.010	.14					
	SRS-2 Social Communication Index	.17	.87	.000	.001	.02					
Camouflaging (*AQ - ADOS*)							3.28	(5, 49)	0.01	.25	.17
	Age	-1.23	.22	-.006	.005	-.17					
	FSIQ-2	-.50	.62	-.001	.002	-.07					
	D-KEFS Trail Making	.85	.40	.014	.016	.13					
	D-KEFS Color-Word Interference	1.80	.08	.022	.012	.28					
	SRS-2 Social Communication Index	2.19	.03	.004	.002	.28					
CAT-Q							0.51	(5, 49)	0.77	0.05	-0.05
	Age	.06	.95	.001	.020	.01					
	FSIQ-2	-.65	.52	-.007	.011	-.10					
	D-KEFS Trail Making	-.01	.99	-.001	.071	.00					
	D-KEFS Color-Word Interference	.49	.63	.270	.055	.09					
	SRS-2 Social Communication Index	1.46	.15	.110	.008	.21					

Note: *TASIT*: *The Awareness of Social Inference Test, Short Version*. *ADOS: Autism Diagnostic Observation Schedule, Second Edition*. FSIQ-2: Two-scale full-scale IQ. *D-KEFS: Delis-Kaplan Executive Functioning System*. *SRS-2*: *Social Responsiveness Scale, Second Edition*. *AQ*: *Autism Quotient*. *CAT-Q*: *Camouflaging Autistic Traits Questionnaire*.

Post-Hoc analysis of camouflaging subgroups. To investigate the autistic traits and diagnostic statuses of participants with high camouflaging scores, I split the sample using median scores on each camouflaging measure (see Table 6). Analyzing sub-samples defined by specific traits sometimes yields important findings that would remain hidden if heterogenous samples of autistic people were analyzed only as one whole sample (Gotham et al., 2018; Herrington et al., 2017). On average, participants with above-median *CAT-Q* scores had higher *ADOS-2* scores, were more likely to have scores above *ADOS-2* diagnostic cutoffs, and were more likely to have

received a previous diagnosis of autism than those with above-median discrepancy scores. Of the 13 participants with above-median scores on all three camouflaging measures, only two had previously received an autism diagnosis and not one scored above *ADOS-2* diagnostic cutoffs. In contrast, of the 18 participants with above-median scores on only one camouflaging measure, six (33%) reported a previous autism diagnosis and twelve (67%) scored above *ADOS-2* diagnostic cutoffs.

Table 6: *Characteristics of Groups Defined by Camouflaging Scores*

		Previously Diagnosed		ASD Per *ADOS-2*		*ADOS-2*		*SRS-2*		*BAPQ*	
Diagnostic Method	*n*	*n*	% group	*n*	% group	*M*	*SD*	*M*	*SD*	*M*	*SD*
Above median for *TASIT - ADOS*	26	4	15.38	2	7.69	2.12	2.69	91.00	22.80	3.94	0.41
Above median for *AQ - ADOS*	28	6	21.43	3	10.71	2.75	3.44	93.07	23.28	3.97	0.43
Above median for *CAT-Q*	27	6	22.22	9	33.33	5.96	6.19	94.00	21.65	3.96	0.47
Above median on one measure	18	6	33.33	12	66.67	9.67	5.40	91.44	25.79	4.04	0.58
Above median on two measures	12	2	16.67	1	8.33	1.83	2.62	81.83	14.83	3.89	0.37
Above median on three measures	13	2	15.38	0	0.00	1.92	2.53	100.00	22.88	3.96	0.40

Note. ASD: autism spectrum disorder. *ADOS-2: Autism Diagnostic Observation Schedule, Second Edition. SRS-2: Social Responsiveness Scale, Second Edition. BAPQ: Broader Autism Phenotype Questionnaire. TASIT: The Awareness of Social Inference Test, Short Version. ADOS-2: Autism Diagnostic Observation Schedule, Second Edition. AQ: Autism Quotient. CAT-Q: Camouflaging Autistic Traits Questionnaire.*

Discussion

In a broad sample of women with autistic traits, most of whom did not meet diagnostic criteria for autism, discrepancy-based camouflaging scores were not significantly associated with self-report camouflaging scores. Also, camouflaging scores generally were poorly predicted by age, IQ scores, performance on executive functioning tests, and self-reported social communication skills. These results speak to the complexity of camouflaging behavior and the ongoing challenge of quantifying this clinically significant construct.

I examined three different methods of quantifying camouflaging. The first was one of the first methods proposed for quantifying camouflaging of autistic traits (Lai et al., 2016), and it involved contrasting a self-report of autistic traits (*AQ*) with clinician-rated autistic traits (*ADOS-2*). The second was a novel discrepancy-based method that also used the *ADOS-2* as a measure of autistic presentation, but it contrasted *ADOS-2* scores with performance on the *TASIT-S*, a video-vignette-based measure of social cognition. The third method was a recently published self-report measure of efforts to camouflage autistic traits, the *CAT-Q*.

Some of the results confirm findings reported in Lai et al. (2016). They found that two discrepancy-based camouflaging scores (*RMET* - *ADOS*, *AQ* - *ADOS*) had overlapping variances such that principal component analysis justified interpreting a single score based on the two. Similarly, my findings show that discrepancy-based camouflaging scores (*TASIT* - *ADOS*, *AQ* - *ADOS*) are significantly associated. These findings are consistent with research showing that autistic traits reported on measures like the *AQ* are associated with performance on tests of social cognition like the *RMET* or *TASIT* (e.g., Sasson, Nowlin, & Pinkham, 2013). The process of subtracting *ADOS* scores from each measure to quantify camouflaging strengthens the association between these measures. Lai et al. (2016) also reported that, for a subsample of

women, discrepancy-based camouflaging scores were associated with executive functioning abilities (*d'* from Go/No-Go task) but not IQ or age. In the present sample of women, discrepancy-based camouflaging scores (*AQ* - *ADOS*) were associated with executive functioning abilities (*D-KEFS Color-Word Interference* scores), albeit at a trend level of statistical significance, but were not associated with IQ or age. One interpretation of these findings is that camouflaging efforts require well-developed executive functioning abilities but not accumulated life experience or intelligence per se. However, both my sample and Lai and colleagues' sample did not include children or individuals with intellectual disability, and thus were relatively restricted in terms of range of age and IQ and less able to detect trends related to these constructs.

The *CAT-Q* and discrepancy-based camouflaging scores disagreed in their identification of individuals who showed above-median camouflaging efforts. This disagreement raises questions about whether these scores are quantifying the same phenomenon. What is the *CAT-Q* measuring that the discrepancy-based scores are not and vice versa? Perhaps the *CAT-Q* is more sensitive to camouflaging efforts than discrepancy methods because its items ask about a broad range of traits (e.g., "When talking to other people, I feel like the conversation flows naturally;" item is reverse scored), whereas items on the *AQ* and *ADOS* tend to be somewhat more specific and possibly more unique to autism. For example, *AQ* item 26 reads "I frequently find that I don't know how to keep a conversation going," and *ADOS-2* item A8 provides specific criteria for evaluating the individual's ability to engage in social conversation. Other potential differences in these methods are related to how they handle awareness of camouflaging efforts and their outcome. Hull et al. (2019) noted that the *CAT-Q* allows the individual to report camouflaging efforts, regardless of whether those efforts were successful, while discrepancy-

based methods theoretically measure efforts that successfully resulted in a less autistic presentation (low *ADOS-2* score). Thus, perhaps the *CAT-Q* measures conscious camouflaging efforts regardless of success, and discrepancy-based methods measure successful camouflaging efforts regardless of conscious intent. This likely explains why – compared to sub-samples of participants with above-median *discrepancy* scores – the sub-sample with above-median *CAT-Q* scores included many more participants with high *ADOS-2* scores and past diagnoses.

Alexithymia may also play a role in the apparent difference between self-report and discrepancy-based methods of quantifying camouflaging. At least 50% of autistic individuals experience severe alexithymia, or difficulty identifying and describing one's own emotions (Berthoz & Hill, 2005; Lombardo et al., 2007). Alexithymia could impact performance on the *TASIT-S* which involves recognizing emotions in others. In fact, in some samples of autistic adults – but not all (Stephenson, Luke, & South, 2019) – alexithymia more strongly predicts poor performance on emotion recognition tasks than autistic traits (Cook, Brewer, Shah, & Bird, 2013). Alexithymia may also contribute to under- or over-reporting of camouflaging efforts on the *CAT-Q*. Six of the twenty-five *CAT-Q* items include the word "feel" and ask the rater to report on a feeling. Consequently, it is possible that participants who struggle with alexithymia performed poorly on the *TASIT* and then under-reported camouflaging efforts on the CAT-Q. These participants would be more likely to have high discrepancy-based camouflaging scores and low *CAT-Q* scores.

Although the discrepancy and self-report scores were not significantly associated, they were similar in that all camouflaging scores were poorly predicted by age, IQ scores, performance on executive functioning tests, and self-reported social communication skills. *SRS-2* Social Communication Index scores significantly predicted *AQ - ADOS* camouflaging scores,

yet, along with other predictors,they accounted for only 17% of the variance in camouflaging. Notably, the regression model showed the relationship between Social Communication Index scores and *AQ - ADOS* camouflaging scores to be opposite of what was expected, with worse self-reported social communication abilities (higher Social Communication Index scores) associated with greater camouflaging. Perhaps greater awareness of social communication problems motivates camouflaging efforts. Or perhaps, here too, issues related to insufficiently sophisticated measurement or limited sampling may have prevented our methods from revealing the true relationships between these constructs. Potential predictors not included in our models that may better predict camouflaging include other-report measures of social cognition or social communication, measures that directly assess motivation to socially conform, and access to skilled and supportive models of appropriate social behaviors.

Study 2: Mental Health Implications

Additional Measures

Psychological distress. The *Depression Anxiety Stress Scales 21* (*DASS-21*; Lovibond & Lovibond, 1995) is the 21-item form of the 42-item self-report *DASS.* The *DASS-21* invites respondents to rate their experience of 7 symptoms each of depression, anxiety, and stress over the past week. The *DASS-21* total score is a valid measure of general psychological distress with high inter-item reliability (Cronbach's $\alpha = 0.93$; Henry & Crawford, 2005).

Suicidality. The *Suicidal Behavior Questionnaire – Revised* (*SBQ-R*; Osman et al., 2001) is a brief, 4-item self-report measure of suicidal behavior that has been validated in clinical and nonclinical samples. Two items assess lifetime incidence of suicidal ideation, threats, and attempts; one item assesses suicidal ideation over the past year; and one item assesses the probability of future attempts. For the future-oriented item ("How likely is it that you will

attempt suicide someday?"), two of the six response options are similar: "Never" and "No chance at all." With the approval of Augustine Osman, Ph.D., one of the measure's authors, I changed the wording of these response options to "Never thought about suicide" and "Thought about suicide, but no chance at all." For a nonclinical, undergraduate sample, a total cutoff score of seven differentiates well between at-risk for suicide and non-suicidal adults with sensitivity of 93% and specificity of 95%. The SBQ-R has not yet been validated in an adult autistic sample, but neither has any other suicide screening measure (Cassidy, Bradley, Bowen, Wigham, & Rodgers, 2018).

Functional challenges. The *World Health Organization Disability Assessment Schedule, Second Edition* (*WHODAS 2.0*; Üstün, 2010) uses twelve face-valid questions to measure disability or dysfunction in six areas: cognition, mobility, self-care, getting along, life activities (e.g., "taking care of household responsibilities"), and community participation. The respondent rates how much difficulty (ranging from "None" to "Extreme or Cannot do") health conditions have caused over the past 30 days for each of the twelve tasks. The measure explicitly includes "mental or emotional problems" which are "short or long lasting" in its definition of health conditions. Before being entered into regression models, total scores reflecting percent decreased functioning were multiplied by one hundred for ease of interpretability (i.e., a score of 100 means the respondent cannot do any of the twelve activities). The 12-item version explains 81% of the variance of the 36-item version which has excellent test-retest reliability (intra-class coefficient of 0.98), and the 12-item version has been validated in autistic adults without intellectual disability (Park et al., 2019).

Participants

The sample includes 58 adult women who completed all measures for this study. Participant ages ranged from 18 to 42 years (M = 25.17, SD = 6.17; see Table 7). IQ ranged from 89 to 140 (M = 114.60, SD = 11.27). Eighteen participants (31%) had received a previous formal diagnosis of autism spectrum disorder (autism or Asperger syndrome): ten were diagnosed in childhood, four in adolescence, and four in adulthood. Twenty-one participants (36%) scored above the diagnostic cutoff on *ADOS-2*. The majority of participants were Caucasian (98.2%), working part time (71.4%), and single or divorced (67.9%), and a significant portion were currently attending college (48.2%; see Table 8).

Data Analyses

I tested ordinary least-squares linear regression models of psychological distress (*DASS-21*), suicidality (*SBQ-R*), and functional challenges (*WHODAS 2.0*) with clinician-rated autistic traits (*ADOS-2*), insight into autistic traits (*SRS-2*, *AQ*), and camouflaging (*CAT-Q*) as potential predictor variables. Discrepancy-based camouflaging scores were not entered as predictors because, unlike the self-report *CAT-Q*, they do not capture unsuccessful camouflaging efforts which theoretically most impact mental health. Also, discrepancy-based camouflaging scores would introduce problematic collinearity (e.g., collinearity between *AQ*, *ADOS-2*, and Camouflaging [AQ – ADOS] scores). To examine associations between entered dependent and predictor variables, I generated scatterplots to confirm linearity. As in Study 1, given the early stage of research about these constructs, I completed simultaneous (versus hierarchical) regressions. Since camouflaging might differentially predict distress depending on the level of severity of autistic traits (e.g., efforts to camouflage more severe traits may be more psychologically taxing), I entered interaction terms in regressions involving the relevant

predictors. Before creating the product terms that represent interactions, I mean-centered the involved quantitative predictors (Warner, 2013). Centered scores were not entered as predictors. Shapiro-Wilk tests showed normality in the distributions of regression residuals (Thode, 2002), scatterplots of residuals against predicted/fitted variables did not show notable heteroscedasticity, and collinearity was not problematic as the variance inflation factors (VIF) for all variables was < 3 (O'Brien, 2007).

To quantify agreement between autism diagnostic measures, I used Cohen's kappa test which accounts for the degree of agreement expected due to random allocation (McHugh, 2012). For each measure, I classified participants for autism "caseness" by applying each tool's published cut score or interpretive guideline: *ADOS-2* (revised Module 4 algorithm) overall scores ≥ 8, *SRS-2* Total scores in the Moderate range (total raw score > 84), and *AQ* scores ≥ 32 were considered indicative of autism.

Power Analyses

Cassidy, Bradley, Shaw, & Baron-Cohen (2018) reported that camouflaging scores based on responses to a custom, study-specific measure, along with seven other predictors, predicted *SBQ-R* scores in a model with an $R^2 = 0.41$. I entered fewer predictors and so expected a smaller R^2 in models of *SBQ-R* and other measures of mental health. A priori power analysis showed that, given the sample size of 58, linear multiple regression with six predictors has sufficient power ($\beta = 0.20$; $\alpha = 0.05$) to detect an R^2 deviation from zero of moderate magnitude ($f^2 = 0.27$; $R^2 = 0.21$). Regression power analyses were conducted using G*Power version 3.1.9.2 (Faul et al., 2009). Given the proportions of classifications for diagnostic measures in the sample (*SRS-2*: 0.53; *ADOS-2:* 0.36; *AQ*: 0.28) and $\alpha = 0.05$, a sample size of thirty-seven was needed to achieve power of 0.8 to detect moderate agreement between measures (Cohen's $\kappa > 0.4$; Cantor, 1996).

Table 7: *Study 2 Participant Characteristics*

	M	(*SD*)	Range
Age in years	25.17	(6.17)	18 - 42
FSIQ-2[a]	114.60	(11.27)	89 - 140
CAT-Q total score	4.73	(0.86)	2.32 - 6.28
DASS-21 total score	55.28	(20.78)	12 - 102
SBQ-R total score	7.98	(3.48)	3 - 17
WHODAS 2.0 total score	0.27	(0.14)	0.20 - 0.63
ADOS-2 total score	6.07	(5.41)	0 - 18
Self-reported autistic traits			
SRS-2 raw total score	90.24	(22.36)	33 - 139
AQ total score	28.57	(6.56)	13 - 43
BAPQ total score	3.90	(0.45)	3.08 - 5.28

Note. FSIQ-2: Two-scale full-scale IQ. *CAT-Q: Camouflaging Autistic Traits Questionnaire*. *DASS-21: Depression Anxiety Stress Scales 21*. *SBQ-R: Suicidal Behavior Questionnaire – Revised*. *WHODAS 2.0*: *World Health Organization Disability Assessment Schedule, Second Edition*. *ADOS-2: Autism Diagnostic Observation Schedule, Second Edition*. *SRS-2: Social Responsiveness Scale, Second Edition*. *AQ: Autism Quotient*. *BAPQ: Broader Autism Phenotype Questionnaire*.

[a]One participant did not complete IQ testing. She had earned a bachelor's degree, suggesting at least average intellectual functioning.

Table 8: *Study 2 Participant Demographics*

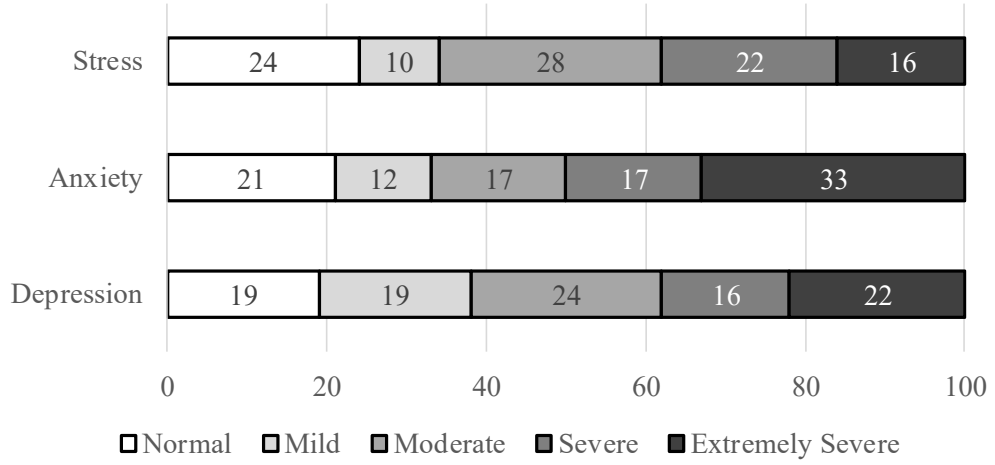
	n	(%)
Previous autism diagnosis		
Diagnosed in childhood/adolescence	14	(25.0)
Diagnosed in adulthood	4	(7.1)
Educational background		
Some high school	2	(3.6)
High school diploma or GED	4	(7.1)
Associate's degree	5	(8.9)
College student	27	(48.2)
Bachelor's degree	15	(26.8)
Graduate degree	5	(8.9)
Relationship status		
Single	36	(64.3)
In a dating relationship	7	(12.5)
Married or engaged	13	(23.2)
Divorced or separated	2	(3.6)
Employment status		
Unemployed	13	(23.2)
Part-time work	40	(71.4)
Full-time work	5	(8.9)
Socioeconomic background		
At least one parent earned a bachelor's degree	50	(89.3)
At least one parent earned an advanced degree	33	(58.9)
Both parents earned bachelor's degrees	25	(44.6)
Both parents earned advanced degrees	5	(8.9)
Ethnicity		
Hispanic or Latino	4	(7.1)
Not Hispanic or Latino	54	(96.4)
Race		
Asian	1	(1.8)
Black or African-American	1	(1.8)
White	55	(98.2)
More than one race	1	(1.8)

Results

This sample of women with significant self-reported autistic traits reported considerable psychological distress. On the *DASS-21*, 62% reported moderate or severe depression, 67% reported moderate or severe anxiety, and 66% reported moderate or severe stress (Figure 3). According to the *SBQ-R,* 62% of participants were at risk for suicide. This distress comes alongside significant everyday functional challenges. Scores on the *WHODAS 2.0* indicate that 57% rated themselves as functioning in a range of everyday activities at three-fourths or less of their full capacity, and 15% of that group rated themselves as functioning at half or less. Participants were most likely to report difficulty on *WHODAS 2.0* items related to social tasks (e.g., "How much of a problem did you have in joining in community activities…?") or emotional health ("How much have you been emotionally affected by your health problems?").

During the in-person assessment, many participants expressed their distress to examiners with comments such as "I'm more worried about making a [social] mistake than dying" or "I was tired of trying [to succeed socially] and making social mistakes, so I started avoiding people." One participant who had a formal diagnosis of autism, shared that she felt "ashamed" about her diagnosis. Another described how she was glad to receive a diagnosis, although it did not make social interactions easier: "I always wondered what was wrong with me. After my diagnosis, I realized nothing was wrong, things are just harder for me. It is nice to have a reason for things. Now I know it is not my fault." Further evidencing their distress, 72% of participants had received psychotherapy, 74% had taken medication for mental health concerns, and 64% were receiving pharmacological or psychotherapy treatment at the time of their participation in the study.

Figure 3: *Clinical Interpretation of DASS-21 Subscale Scores*



Note. A substantial majority of participants reported experiencing clinically significant psychological distress across subscales, with more than one-third reporting severe or extremely severe levels of concern. The numbers on the stacked bars represent percentages of the sample that scored in the respective interpretive range.

On the *CAT-Q*, the present sample reported camouflaging to a degree very similar to that reported for the measure's autistic validation sample, with 55% of the sample reporting camouflaging above the autistic sample's mean. Of the three CAT-Q subscales, participants were most elevated on the masking subscale that assesses "strategies used to hide autistic characteristics or portray a non-autistic persona," with 74% of the sample reporting masking above the autistic sample's mean (see Table C1).

Models of autistic traits, camouflaging, and mental health. A regression model of psychological distress (*DASS-21* total scores) was statistically significant, $F(6, 51) = 2.30$, $p = .048$, and accounted for 12% of the variance in distress (see Table 9). The model showed that camouflaging efforts (*CAT-Q* total scores) significantly predict such distress in the sample ($\beta = 0.29$, $p = .03$), and self-reported autist traits (*SRS-2* raw total scores) approached significance as a predictor ($\beta = 0.30$, $p = .06$). A separate regression model of functional challenges (*WHODAS*

2.0 total scores) was also statistically significant, $F(6, 51) = 2.56$, $p = 0.03$, and accounted for 14% of the variance in such challenges. In this model, self-reported autistic traits (*SRS-2* raw total scores) significantly predicted functional challenges in the sample ($\beta = 0.33$, $p = .04$), while camouflaging efforts (*CAT-Q* total scores) approached significance as a predictor ($\beta = 0.24$, $p = .06$). A regression model of suicidality (*SBQ-R* scores) was not statistically significant, $F(6, 51) = 1.43$, $p = 0.22$. Neither clinician-rated autistic traits (*ADOS-2* scores) nor self-reported autistic traits per the *AQ* significantly predicted any of the mental health measures. Hypothesized interactions between self-reported autistic traits and camouflaging efforts were also not statistically significant in any model.

Table 9: *Linear Regression Models of Mental Health Indicators*

Psychological distress							2.30	(6, 51)	.048	.21	.12
	ADOS-2	-.48	.50	-.95	.35	-.12					
	SRS-2	.30	.15	1.97	.06	.30					
	AQ	-.50	.51	-.99	.33	-.16					
	CAT-Q	7.12	3.16	2.26	.03	.29					
	*SRS-2*CAT-Q*	-.19	.16	-1.14	.26	-.23					
	*AQ*CAT-Q*	.18	.60	.30	.77	.06					
Suicidality							1.43	(6, 51)	.22	.14	.04
	ADOS-2	.01	.08	.17	.86	.02					
	SRS-2	.04	.03	1.52	.14	.24					
	AQ	.11	.09	1.25	.22	.21					
	CAT-Q	-.33	.53	-.62	.54	-.08					
	*SRS-2*CAT-Q*	-.01	.03	-.54	.59	-.11					
	*AQ*CAT-Q*	.07	.10	.72	.47	.15					
Functional challenges							2.56	(6, 51)	.03	.23	.14
	ADOS-2	-.003	.003	-.98	.33	-.13					
	SRS-2	.002 <	.001	2.17	.04	.33					
	AQ	.001	.003	.33	.75	.05					
	CAT-Q	.038	.020	1.90	.06	.24					
	*SRS-2*CAT-Q*	-.001	.001	-1.01	.32	-.20					
	*AQ*CAT-Q*	.005	.004	1.25	.22	.25					

Note: Psychological distress = *Depression Anxiety Stress Scales 21* total score. Suicidality = *Suicidal Behavior Questionnaire - Revised* total score. Functional challenges = *World Health Organization Disability Assessment Schedule, Second Edition* total score. *ADOS-2: Autism Diagnostic Observation Schedule, Second Edition. SRS-2: Social Responsiveness Scale, Second Edition. AQ: Autism Quotient. CAT-Q: Camouflaging Autistic Traits Questionnaire.*

Diagnostic measures' characterization and agreement. The *SRS-2* identified the most participants as having difficulties consistent with a diagnosis of autism (n = 31; 53% of the sample), followed by the *ADOS-2* (n = 21; 36%), and *AQ* (n = 16; 28%). Approximately seventy-one percent of the sample – including all participants previously diagnosed with autism – had scores in the range of severity consistent with autism on at least one measure, yet no single measure or combination of measures classified all previously diagnosed participants as autistic (see Table 10). A review of Table 10 shows there is no clear pattern between diagnostic stringency and the mental health variables or camouflaging scores. There was only fair or poorer agreement ($\kappa < 0.4$; Landis & Koch, 1977) on diagnostic classification between pairs of the three measures (Table 11). The *ADOS-2* showed moderate agreement with diagnostic status at the time of enrollment ($\kappa = 0.58$, $p < .001$), but the other measures showed only fair or poorer agreement with this status. Agreement between measures did not significantly improve when we considered only participants in the Severe range (total raw score > 112; n = 11) on the *SRS-2*.

Post-Hoc analysis of high-camouflaging subgroup. Investigation of the scatterplots created before the regression analyses revealed that camouflaging seemed to relate to measures of distress and functional challenges more strongly for participants who reported high levels of camouflaging versus those who reported low levels. Therefore, we used the reported mean *CAT-Q* total score of autistic adults in the validation sample (4.79) to split our sample into two groups: high-camouflaging (n = 32) and low-camouflaging (n = 26). Twelve members (38%) of the high-camouflaging sub-group had autism per their score on the *ADOS-2*, and nine (28%) had received autism diagnoses prior to their participation. I completed Doornik-Hansen omnibus tests to confirm bivariate normality in the relationships between *CAT-Q* total scores and each mental health measure (*DASS-21*, *SBQ-R*, *WHODAS 2.0*; Doornik & Hansen, 2008). I then calculated

Pearson correlations between *CAT-Q* total scores and scores on the mental health measures, first in the high-camouflaging subgroup, and then in the low-camouflaging subgroup for comparison. In the high-camouflaging subgroup, *CAT-Q* total scores were significantly associated with each measure of mental health. In the low-camouflaging subgroup, *CAT-Q* total scores were not associated with any of the three measures of mental health (ps > 0.2; Table 12).

I also investigated agreement between diagnostic measures in high-camouflaging subgroup. There was poor agreement between the *ADOS-2* and self-report measures but fair agreement between the *SRS-2* and *AQ* ($\kappa = 0.31$, $p = .02$; Table C2).

Post-Hoc analysis of participant characteristics by *ADOS-2* diagnostic classification. To investigate whether participant characteristics varied significantly by *ADOS-2* diagnostic classification, I completed *t*-tests to compare the participants who were autistic per the *ADOS-2* with those who were not (Table C3). On average, those who met *ADOS-2* criteria for autism spectrum disorder were older by about five years. Otherwise, there were no significant differences on participant characteristics, including on the dependent variables in the regression analyses (i.e., *DASS-21*, *SBQ-R*, *WHODAS 2.0*). Group mean differences for non-normal variables were confirmed with Whitney-Mann *U* tests.

Table 10: *Characteristics of Groups Defined by Diagnostic Measures and Diagnosis*

			Previously Diagnosed		*CAT-Q*		*DASS-21*		*SBQ-R*		*WHODAS 2.0*	
Diagnostic Method	*n*	% sample	*n*	% group	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
ASD per any measure	41	70.7	18	43.9	4.86	0.78	57.27	20.47	8.49	3.79	0.26	0.13
ASD per *SRS-2*	31	53.4	14	45.2	4.89	0.82	60.45	20.98	8.74	3.69	0.29	0.12
ASD per one measure	22	37.9	7	31.8	4.82	0.74	59.00	18.19	7.41	3.13	0.24	0.13
ASD per *ADOS-2*	21	36.2	14	66.7	4.73	0.69	53.43	21.35	8.62	4.06	0.25	0.11
ASD per previous diagnosis	18	31.0	18	100.0	4.52	0.78	55.33	19.55	8.67	3.74	0.26	0.11
ASD per *AQ*	16	27.6	7	43.8	4.92	0.89	51.50	23.35	9.38	4.03	0.28	0.16
ASD per two measures	11	19.0	5	45.5	5.08	0.85	57.09	21.42	10.55	4.68	0.29	0.16
ASD per three measures	8	13.8	6	75.0	4.66	0.81	52.75	26.70	8.63	3.34	0.29	0.07
ASD per three measures and previous diagnosis	6	10.3	6	100.0	4.68	0.90	56.33	30.18	9.83	2.64	0.30	0.07

Note. ASD: autism spectrum disorder. *ADOS-2: Autism Diagnostic Observation Schedule, Second Edition. AQ: Autism Quotient. SRS-2: Social Responsiveness Scale, Second Edition. CAT-Q: Camouflaging Autistic Traits Questionnaire. DASS-21: Depression Anxiety Stress Scales 21. SBQ-R: Suicidal Behavior Questionnaire – Revised. WHODAS 2.0: World Health Organization Disability Assessment Schedule, Second Edition.*

Table 11: *Cohen's Kappa Agreement Between Diagnostic Measures*

	Expected Agreement	Agreement	κ	*SE*	*z*	*p*	(95% CI)
ADOS-2 & SRS-2	49.05%	58.62%	0.19	0.12	1.52	0.06	(-0.05, 0.42)
ADOS-2 & AQ	56.18%	67.24%	0.25	0.13	1.96	0.03	(-.004, 0.51)
SRS-2 & AQ	48.45%	60.34%	0.23	0.11	2.03	0.02	(0.02, 0.44)

Note. $0.21 < \kappa < 0.4$ suggests fair agreement. *ADOS-2: Autism Diagnostic Observation Schedule, Second Edition. SRS-2: Social Responsiveness Scale, Second Edition. AQ: Autism Quotient.*

Table 12: *Correlations Between CAT-Q Total Scores and Measures of Mental Health for High- and Low-Camouflaging Subgroups*

	High-Camouflaging (n = 32)		Low-Camouflaging (n = 26)	
	r	*p*	*r*	*p*
DASS-21 total score	0.36	0.04	0.25	0.22
SBQ-R total score	0.37	0.04	0.05	0.81
WHODAS 2.0 total score	0.46	0.01	0.08	0.69

Note. Members of high-camouflaging subgroup have *CAT-Q* total scores > 4.79 (the mean score of autistic adults in the validation sample; Hull et al., 2019); members of the low-camouflaging subgroup have scores <= 4.79. *CAT-Q: Camouflaging Autistic Traits Questionnaire. DASS-21: Depression Anxiety Stress Scales 21. SBQ-R: Suicidal Behavior Questionnaire - Revised. WHODAS 2.0: World Health Organization Disability Assessment Schedule, Second Edition.*

Discussion

A majority of the sample reported significant psychological distress, suicidality, and reduced daily functioning. Higher *CAT-Q* scores significantly predicted more distress while measures of autistic traits (*ADOS-2, AQ,* and *SRS-2*) did not. *CAT-Q* scores also predicted functional challenges, albeit at a trend-level statistical significance and in addition to self-reported autistic traits (*SRS*-2 total scores). For a subsample of participants with higher-than-average *CAT-Q* camouflaging scores, *CAT-Q* scores were significantly associated with psychological distress, suicidality, and reduced functioning.

These findings echo results from adults diagnosed with autism as reported in Cassidy, Bradley, Shaw, & Baron-Cohen (2018) showing that self-reported suicidality (*SBQ-R*) was not associated with *AQ* scores. In contrast, in our intentionally broader sample that includes women in the diagnostic "gray zone," I did not replicate their finding in a diagnosed sample that self-reported camouflaging predicted suicidality in autistic adults (Cassidy, Bradley, Shaw, & Baron-Cohen, 2018).

Relationship between autistic traits and mental health. The high prevalence of mental health concerns in the present sample raises the question of whether these concerns are common among women with autistic traits, or autistic traits are common among women with mental health concerns, or likely both. What is clear from the results is that many widely used autism diagnostic measures do not capture autistic traits' impact on the mental health of women. This is not a flaw in the diagnostic measures since they are designed to have sufficient discriminant validity to measure autism and *not* similar or related concerns. The *SRS-2* is notable for strongest associations with mental health concerns; however, the *SRS-2* (as well as the original *SRS*) has been shown to have problematic discriminant validity vis-à-vis other mental health concerns such as anxiety or disruptive behavior disorders (Cholemkery, Kitzerow, Rohrmann, & Freitag, 2014; Cholemkery, Mojica, Rohrmann, Gensthaler, & Freitag, 2014; South et al., 2017). I am not advocating for the use of one diagnostic measure or another. Rather, my findings emphasize the importance of thorough, multi-method assessment of mental health concerns in women with autistic traits, as such concerns may mask or exaggerate autistic traits. For example, Gotham et al. (2018) found that autistic adults showed neural activity in response to emotional stimuli that seemed different from neurotypical peers, yet similar to *depressed* neurotypical peers. This finding suggests that traits often attributed to autism (e.g., ruminative thoughts; Gotham et al.,

2014), may be better explained by depression or other mental health concerns. Clinicians must carefully consider how mental health concerns affect presentation of autism symptoms, and vice versa. One important strategy for doing this is to listen carefully and thoroughly to the individual client (Crane, Adams, Harper, Welch, & Pellicano, 2019).

Relationship between camouflaging and mental health. Study findings suggest that camouflaging efforts are pervasive among women who perceive themselves as socially atypical, regardless of whether they have been or could be diagnosed as autistic. These findings also suggest that assessing camouflaging efforts is clinically relevant because, although camouflaging behaviors may often be adaptive and facilitate social inclusion, they can predict psychological distress and are associated with suicidality and functional challenges. Given growing evidence that camouflaging is generally associated with significant mental health concerns, clinicians who administer interventions that promote camouflaging efforts should consider whether these efforts are manageable and in line with the patient's values (Camm-Crosbie, Bradley, Shaw, Baron-Cohen, & Cassidy, 2018; Crane et al., 2019).

Environmental factors may contribute to explaining the association between camouflaging and poor mental health. Perhaps camouflaging efforts come about in response to feeling social exclusion, low self-concept, or low self-acceptance. Women may be most likely to feel different and attempt camouflaging if their environments are invalidating, unaccommodating, or unsupportive. At a personal level, women with autistic traits may experience the "double-empathy problem" wherein they struggle to understand or empathize with peers, and peers struggle to understand them (Milton, 2012). This may be particularly true for women who successfully camouflage autistic traits, and so others are unaware of the traits and their impact. On a societal level, women often face environments that are abusive or

discriminatory,regardless of whether they have autistic traits. Women are more likely to have histories of abuse (Cutler & Nolen-Hoeksema, 1991; Springer, Sheridan, Kuo, & Carnes, 2007). Women are also more likely to be treated unfairly in the workplace, especially if they fail to conform with gender-based norms for social behavior, perhaps because of autistic traits (Heilman & Okimoto, 2007).

Utility of diagnostic tools. The lack of acceptable agreement between diagnostic tools is concerning for many reasons, but perhaps especially because, for many, a proper diagnosis leads to greater self-acceptance, a sense of belonging in the autism community, and access to appropriate care, including support in managing anxiety, suicidality, and the many challenges inherent in navigating the neurotypical social space (Jones et al., 2014). Widespread camouflaging efforts in the present sample may partly explain lower scores on the *ADOS-2* and *AQ*. Also, it seems likely that these measures best detect a male profile of autism (e.g., the *AQ* asks about special interests more common among males, such as collecting cars and trains). My findings support calls for new diagnostic tools that are sensitive to the female profile of autism (Lai et al., 2015). In the meantime, it is important for clinicians assessing autism concerns in women to not rely solely on the *ADOS-2* or self-report measures. Instead, it may be helpful to observe the woman in multiple social contexts and to get collateral information from people familiar with her.

General Discussion

Limitations and Strengths

These studies have notable limitations. First, the all-female sample was relatively homogenous in terms of age, cognitive ability, ethnicity, and socioeconomic background. The findings may not generalize to males, children, individuals with intellectual challenges, people of

color, or individuals who experience poverty or other significant psychosocial stressors unaccounted for in the study design. Second, while all participants reported autistic traits and social challenges, the sample was heterogenous in terms of clinical concerns, and findings may not generalize to groups defined by specific diagnoses. Third, the validity of findings may be impacted by mono-operation bias as several of the constructs were quantified using a single measure. Fourth, since many measures were self-report (e.g.., *CAT-Q*, *SRS-2*, *AQ*), common-method variance possibly inflated the associations between constructs, including between predictors and dependent variables in regression analyses. Fifth, although many analyses were sufficiently powered, the study has low (< 0.8) power to detect some effects of interest, especially in the small high-camouflaging subgroup. And sixth, the cross-sectional study design does not allow for investigation into questions regarding causality or change trajectories over time.

These studies also have notable strengths. The unique and inclusive sample of women with autistic traits allowed me to investigate constructs dimensionally and trans-diagnostically. Arguably, unlike many "clean" research samples, the present sample represents a broad range of women with autistic traits who seek clinical services: some participants are autistic women with autism diagnoses, some are probably autistic women who are undiagnosed due to successful camouflaging efforts, and some are neurotypical women with autistic traits. Another strength is that Study 1 incorporated multiple methods of quantifying camouflaging. To my knowledge, this is the first study to report both self-report and discrepancy-based camouflaging scores in the same sample. Lastly, a significant strength of Study 2 was that it incorporated a measure of daily functional challenges in addition to measures of distress. To my knowledge, this is the first study to report on the relationship between camouflaging of autistic traits and functional challenges.

Future Directions

Study 1 was not designed to determine which method of quantifying camouflaging is best. Rather, the study was designed to determine the extent to which different methods agree, and to explore potential mechanisms of camouflaging. However, our findings of disagreement and poor predictors raise questions: Which method of quantifying camouflaging is most accurate? In discrepancy-based methods, what information is gained or lost when multiple measures are condensed into a single camouflaging statistic? What circumstances support camouflaging behaviors? Future studies can investigate these questions. Which method of quantifying camouflaging is best may depend on the clinical context. For example, a measure of camouflaging that assesses efforts to suppress/initiate specific behaviors related to diagnostic criteria for autism may be most helpful in an autism assessment context, while a camouflaging measure that assesses broad efforts to change oneself to "fit in" may be more helpful to a clinician who is formulating treatment goals.

Context is not only relevant because it informs measure selection. Future studies may reveal context to be the most significant predictor of camouflaging behavior. People presumably do not camouflage when alone, and they seem to camouflage more in certain situations and in the presence of certain people. Recent research investigated camouflaging in twenty-two contexts which the authors categorized as "formal" (e.g., work) or "interpersonal" (e.g., home; Cage & Troxell-Whitman, 2019). Interestingly, individuals who camouflaged inconsistently across contexts ("switchers") reported poorer mental health. Other potential predictors of camouflaging not included in the present study are numerous. They include information processing speed, social imitation ability, the perceived ratio of successful to unsuccessful camouflaging efforts, and the perceived costs of *not* camouflaging – costs which may be highest

for individuals who experience social anxiety, have a history of bullying, or face cultural pressures to conform.

Camouflaging is a massive, complex construct that theoretically includes effortfully engaging in *any* socially typical behavior. Relationships between camouflaging and any other construct are likely to be similarly complex. For example, considering the relationship between camouflaging and age, individuals may become more likely to create a niche environment that requires less camouflaging (Livingston & Happé, 2017), yet over time they may accumulate more social trauma which motivates more camouflaging. Furthermore, over time they may feel exhausted by unsuccessful camouflaging and reduce their camouflaging efforts, or their camouflaging may be powerfully rewarded by their social environment such that they maintain or increase their camouflaging efforts. Future studies seeking to explain and predict camouflaging may benefit from narrowing the construct and investigating specific dimensions of camouflaging, such as nonverbal behaviors (vs. verbal), digital contexts (vs. in-person), flexible strategies (vs. inflexible), sustainable efforts (vs. exhausting), or insightful efforts (vs. without social insight).

Study 2 findings regarding camouflaging and social difficulties (*SRS-2*) harmonize with a Cassidy, Bradley, Shaw, & Baron-Cohen (2018) finding that camouflaging and unmet support needs were risk factors for severe psychological distress. Together, these results suggest that self-perceived social atypicality and social isolation likely are key predictors of mental health challenges in individuals with autistic traits. Somewhat ironically, feeling chronically different from their peers may be something people with autistic traits all share regardless of diagnostic status. Along with increasing public awareness of autism, there is increasing awareness that loneliness is a widespread public health concern (Holt-Lunstad, Robles, & Sbarra, 2017; Leigh-

Hunt et al., 2017). As society adapts to address loneliness in the neurotypical majority, there is opportunity to create inclusive communities that can meet the social needs of all people, including those with autistic traits. Future research can explore how best to socially include women with autistic traits, and if increased social connection reduces psychological distress and increases functional capacity.

We echo others in encouraging future, longitudinal studies that involve samples broad enough to include undiagnosed (potentially camouflaged) autistic women (Halladay et al., 2015; Livingston & Happé, 2017). In fact, significant efforts to camouflage socially atypical traits may be common in individuals who have received one of many diagnostic labels, such as social phobia, mood disorder, attention-deficit/hyperactivity disorder, schizophrenia spectrum disorder, personality disorder, etc. Thus, exploring camouflaging in even broader trans-diagnostic samples will generate understanding about what, if anything, distinguishes camouflaging efforts by autistic people.

Conclusion

Women with autistic traits sometimes camouflage those traits to appear similar to neurotypical peers (Hull et al., 2017). Findings from past studies have suggested that camouflaging may delay proper diagnosis and contribute to clinically significant psychological distress, including suicidality (Cassidy, Bradley, Shaw, & Baron-Cohen, 2018; Lehnhardt et al., 2016). Using data from a unique sample of women who reported social challenges and broad autistic traits, I examined associations between multiple measures of camouflaging, modeled potential mechanisms of camouflaging, and investigated camouflaging's relationship with indices of mental health. Analyses showed that self-report and discrepancy-based measures of camouflaging behaviors are not significantly associated, and scores from the multiple measures

are poorly predicted by age, IQ, self-reported social cognitive abilities, and performance on executive functioning tasks. Participants' self-reported camouflaging efforts are significantly associated with psychological distress, even after accounting for severity of autistic traits. Finally, clinician-administered and self-report diagnostic measures demonstrate only fair or poorer agreement with each other in identifying participants as autistic. These findings suggest that mental health concerns in women with autistic traits warrant careful assessment, accounting for the possibility of camouflaging. Also, these findings suggest that clinicians should thoughtfully consider if interventions that encourage camouflaging efforts are appropriate for any given client, since such efforts may lead to worse mental health.

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Appendix A

Complete List of Measures Administered to Adult Participants

- *Autism Diagnostic Observation Schedule, Second Edition, Module 4* (*ADOS-2*)
- *Autism Quotient* (*AQ)*
- *Broad Autism Phenotype Questionnaire* (*BAPQ*)
- *Camouflaging Autistic Traits Questionnaire* (*CAT-Q)*
- *Delis-Kaplan Executive Functioning System (D-KEFS): Color-Word Interference Test, Trail Making Test*
- *Depression Anxiety Stress Scales 21* (*DASS-21)*
- Developmental history questionnaire and follow-up interview
- *Social Responsiveness Scale, Second Edition, Adult Self-Report* (*SRS-2*)
- *Suicidal Behavior Questionnaire – Revised* (*SBQ-R*)
- *Tennessee Self-Concept Scale, Second Edition* (*TSCS:2)*
- *The Awareness of Social Inference Test, Short Version* (*TASIT-S*)
- *Wechsler Abbreviated Scale of Intelligence, Second Edition* (*WASI-II*)
- *World Health Organization Disability Assessment Schedule, Second Edition* (*WHODAS 2.0*)

Complete List of Measures Administered to Adult Participants' Parents

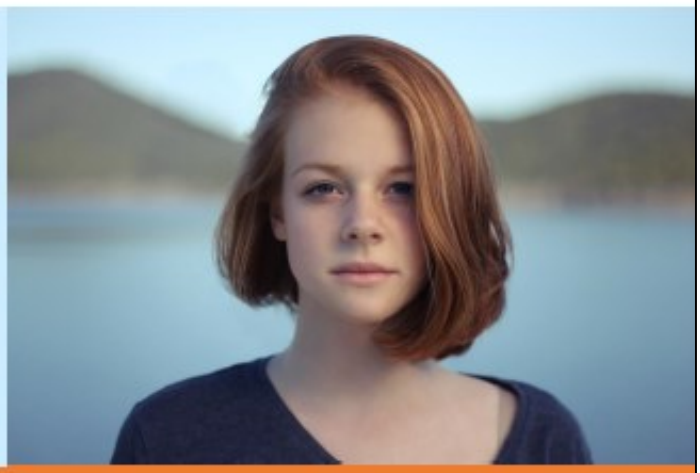
- *Behavior Rating Inventory of Executive Function* (*BRIEF*)
- Developmental history questionnaire and follow-up interview
- *Social Responsiveness Scale, Second Edition, Adult Other-Report* (*SRS-2*)
- *Social Vulnerability Questionnaire* (*SVQ*)

Appendix B

Recruitment Flyer

Research Opportunity for Females 14+

If you find social interactions much more challenging or distressing than your peers, we invite you to participate in a research study of females 14 years or older.



In **SOCIAL SITUATIONS**, do you often find yourself...

CONFUSED? ANXIOUS? EXHAUSTED?

Participation involves completing online questionnaires and possibly a two-hour in-person session involving cognitive tests and a brief interview.

Depending on your level of participation, you will be compensated $5-$40.

Please contact us at social_study@byu.edu or 801-422-5977.

Research Study: Females 14+ social_study@byu.edu 801-422-5977

Appendix C

Table C1: *CAT-Q Subscale Scores*

	Autistic Validation Sample (n = 200; Hull et al., 2019)		Full Sample (N = 58)				High Camouflaging Sample (n = 32)			
	*M**	*SD*	M	*SD*	*n* > *M**	% group	M	*SD*	*n* > *M**	% group
Compensation	4.42	1.31	4.38	1.10	29	50.0	5.07	0.79	26	81.3
Masking	4.55	1.35	5.00	0.98	43	74.1	5.54	0.61	31	96.9
Assimilation	5.29	1.15	4.86	1.18	21	36.2	5.50	0.83	18	56.3
Total	4.79	0.99	4.73	0.86	32	55.2	5.36	0.38	32	100.0

*Note. M**: mean score of the autistic validation sample reported in Hull et al. (2019).

Table C2: *Cohen's Kappa Interrater Agreement Analyses for High-Camouflaging Sub-Group (n = 32)*

	Expected Agreement	Agreement	κ	*SE*	*z*	*p*	(95% CI)
ADOS-2 & SRS-2	46.88%	56.25%	0.18	0.16	1.13	0.13	(-0.12, 0.47)
ADOS-2 & AQ	54.69%	62.50%	0.17	0.18	0.98	0.16	(-0.18, 0.52)
SRS-2 & AQ	45.31%	62.50%	0.31	0.15	2.17	0.02	(0.06, 0.57)

Note. $0.21 < \kappa < 0.4$ suggests fair agreement. ADOS-2: Autism Diagnostic Observation Schedule, Second Edition. SRS-2: Social Responsiveness Scale, Second Edition. AQ: Autism Quotient.

Table C3: *Participant Characteristics by ADOS-2 Diagnostic Classification*

	Autistic Per *ADOS-2* (n = 21)			Not Autistic Per *ADOS-2* (n = 37)				
	M	(*SD*)	Range	*M*	(*SD*)	Range	*t*	
Age in years	28.14	(7.95)	18 - 42	22.73	(3.75)	18 - 34	-3.52	**
FSIQ-2	112.90	(2.42)	89 - 127	115.83	(11.40)	94 - 140	0.86	
CAT-Q total score	4.73	(0.69)	3.16 - 5.64	4.73	(0.95)	2.32 - 6.28	0.01	
DASS-21 total score	53.43	(21.35)	26 - 102	56.32	(20.67)	12 - 102	0.51	
SBQ-R total score	8.62	(4.06)	3 - 17	7.62	(3.10)	3 - 15	-1.05	
WHODAS 2.0 total score	0.25	(0.11)	0.04 - 0.42	0.27	(0.15)	0.02 - 0.63	0.61	
ADOS-2 total score	12.24	(3.21)	8 - 18	2.57	(2.42)	0 - 7	-12.97	***
Self-reported autistic traits								
SRS-2 raw total score	95.43	(21.74)	61 - 139	87.30	(22.46)	33 - 136	-1.34	
AQ total score	30.48	(6.87)	17 - 43	27.49	(6.21)	13 - 42	-1.70	†
BAPQ total score	3.98	(0.52)	3.22 - 5.28	3.86	(0.41)	3.08 - 4.72	-1.02	

Note. FSIQ-2: Two-scale full-scale IQ. *CAT-Q: Camouflaging Autistic Traits Questionnaire. DASS-21*: *Depression Anxiety Stress Scales 21*. *SBQ-R: Suicidal Behavior Questionnaire – Revised. WHODAS 2.0*: *World Health Organization Disability Assessment Schedule, Second Edition*. *ADOS-2: Autism Diagnostic Observation Schedule, Second Edition. SRS-2: Social Responsiveness Scale, Second Edition. AQ: Autism Quotient. BAPQ: Broader Autism Phenotype Questionnaire*. **p ≤ .01. ***p ≤ .001. †p ≤ .10. Nonparametric tests (Mann-Whitney) confirmed results for variables with non-normal distributions. One participant in the Not Autistic per *ADOS-2* group did not complete IQ testing. She earned a bachelor's degree, suggesting at least average intellectual functioning.

Appendix D

Summary of Changes from Approved Prospectus

1. The project proposed in the prospectus called for a sample of both adolescents and adults. At the time of the defense, the committee recommended using an adult-only sample to eliminate the complexity introduced by using a sample of participants at significantly different developmental stages.
2. The prospectus included two aims which required the study team to categorize each participate as qualifying for an autism diagnosis or not:
    - "Describe the difference in distress and dysfunction between adolescent and adult females who qualify for an autism spectrum disorder diagnosis and those who do not."
    - "Investigate the sensitivity and specificity of various autism diagnostic tools (i.e., *ADOS-2*, *SRS-2*) in this diagnostically challenging sample."

    Early into the project, it became clear that many participants had complex histories of clinical concerns which could not be adequately assessed in the context of the research study. The study team determined that with insufficient information it would be inappropriate to make clinical decisions as to whether participants qualified for a diagnosis of autism, and the aims listed above were not pursued.
3. The prospectus stated that all *ADOS-2* administrations would be completed by examiners who were "blind" to the participant's previous diagnostic status. When the study team decided to not diagnose participants, then the purity of the diagnostic process became less essential to the project. Most *ADOS-2* administrations were not completed by a blind examiner.

4. The study team replaced the *Symptom Checklist-90-R* (*SCL-90-R*) and *Liebowitz Social Anxiety Scale* (*LSAS*) with the *Depression Anxiety and Stress Scales (DASS-21)*. This project was completed in the context of a larger research study involving many measures (see General Methods: Procedure, and Appendix A), and the two measures were replaced with one shorter measure (*DASS-21*) in the interest of reducing the demand placed on participants.
5. The *Camouflaging Autistic Traits Questionnaire (CAT-Q*) was published after the project had begun. The study team immediately recognized the relevance of the *CAT-Q* to achieving the study aims and added the measure to the battery.
6. The *Autism Spectrum Quotient (AQ*) was also added to the battery after the start of the project. Initially, the *AQ* was not included because it is similar to the *BAPQ* which the study uses as a screening measure. Later, the *AQ* was added to allow for the calculation and analysis of a third camouflaging measure, and to potentially replicate and extend past findings (Lai et al., 2016).
7. The project described in the prospectus included a single parent-report measure, the *Social Vulnerability Questionnaire* (*SVQ*). Multiple participants declined to provide consent to have the study team contact their parents. Of the parents contacted, only about half completed the *SVQ*. Including the *SVQ* in analyses would have significantly reduced the sample size and statistical power, so it was excluded.