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# ADAPTATION OF AUTISM SPECTRUM QUOTIENT AND CAMOUFLAGING AUTISTIC TRAITS-QUESTIONNAIRE INTO ESTONIAN: EXPLORING POSSIBLE GENDER EFFECTS

Master's thesis

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Running head: Adaptation of autism questionnaires

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# Adaptation of Autism Spectrum Quotient and Camouflaging Autistic Traits-Questionnaire into Estonian: exploring possible gender effects

## Abstract

Diagnosing autism in adults is difficult. Current paper tries to fill a gap in self-report screening instruments by adapting into Estonian two questionnaires: Autism Spectrum Quotient (AQ, Baron-Cohen et al., 2001) and Camouflaging Autistic Traits-Questionnaire (CAT-Q, Hull et al., 2019). Sample ($N$ = 498, $f$ = 409, $m$ = 89) consisted of autistic ($n$ = 42), self-suspected autistic ($n$ = 105), autistic close relative ($n$ = 95) and non-autistic ($n$ = 256) participants. Using exploratory factor analysis, a 5-factor solution was found in AQ-24, total variance explained was 44.2% with Cronbach's alpha of .86. CAT-Q-25, with five new items, retained the original three-factor solution, with total variance explained 56.1% (Cronbach's alpha .95). As expected, correlations between autism questionnaires were higher than questionnaires measuring related constructs. Although correlation with anxiety measures i.e., Social Phobia and Anxiety Inventory (Turner et al., 1989) were significantly high as well. Group and sex interaction effect onto CAT-Q-25 total and subscale scores when controlling for either general or social anxiety revealed that a statistically significant interaction effect appeared only when controlling for social anxiety. It is worth considering applying item response theory approach to find the best set of questions. It is also important to explore both sex effects in autism and the effects of anxiety to autism related traits, and the possible ways how anxiety might affect autistic individuals.

*Keywords*: autism, adults, Autism Spectrum Quotient (AQ), Camouflaging Autistic Traits-Questionnaire (CAT-Q), adaptation

**Autismiküsimustiku ja kamuflaažiküsimustiku adapteerimine eesti keelde: soo võimalike mõjude uurimine**

**Lühikokkuvõte**

Autismi diagnoosimine täiskasvanueas on keerukas. Tööga püütakse täita lünka enesekohaste sõelküsimustike osas, adapteerides eesti keelde autismiküsimustiku *Autism Spectrum Quotient* (AQ, Baron-Cohen et al., 2001) ja *Camouflaging Autistic Traits-Questionnaire* (CAT-Q, Hull et al., 2019). Valim (*N* = 498, f = 409, m = 89) hõlmas autistlikke (n = 42), endal autismi kahtlustanud (n = 105), autistliku lähisugulasega (n = 95) ja mitteautistlikke (n = 256) osalejaid. Uurivat faktoranalüüsi kasutades leiti, et sobivaim faktorlahend AQ-24 küsimustikule oli 5-faktoriline, seletades koguvariatiivsusest 44,2% (sisereliaablus 0,86). CAT-Q-25, koos viie uue pakutud väitega, säilitas leitud kolmefaktorilise lahendi, seletades koguvariatiivsusest 56,08% (Cronbach'i alfa 0,95). Pearsoni korrelatsioonid autismiküsimustike vahel olid suuremad võrreldes korrelatsioone lähedaste konstruktidega. Kuigi ärevust mõõtvate instrumentidega nt. sotsiaalfoobia ja ärevuse (SPAI, Turner jt, 1989) jt küsimustik, olid korrelatsioonid siiski kõrged. Ärevust või sotsiaalärevust kontrollides grupi ja soo koosmõju küsimustike skooridele kadus, välja arvatud CAT-Q-25, kus tulemused jäid sotsiaalärevust arvesse võttes püsima. Tasuks kaaluda üksikküsimuste analüüsi kasutamist, et leida kasutamiseks parim küsimuste komplekt. Samuti on oluline uurida nii soo mõjusid autismis kui ka ärevuse mõjusid autismiküsimustike tulemustele, ning ka võimalikke viise kuidas ärevus võiks autismispektris inimesi mõjutada.

*Märksõnad:* autism, täiskasvanud, Autismiküsimustik (AQ) ja Kamuflaažiküsimustik (CAT-Q), adapteerimine

# Introduction

## Autism spectrum disorders

With time, awareness concerning autism spectrum disorders has increased and focus has been shifting on diagnosing autism in adult populations. Autism spectrum disorders (autism; APA, 2013) are pervasive neurodevelopmental disorders, estimated prevalence rate being ca 1% in general population to 2.64% incl high risk subgroup (Baxter et al., 2015; Kim et al., 2011). The prevalence of autism in adults suggests it to be around 0.8-1% (Brugha et al., 2009), yet there might exist a subset of undiagnosed autistic people, who due to lack of tools to identify adults, insufficient developmental history as well as co-morbid disorders make diagnosing in adulthood difficult (Spencer et al., 2011).

Autism is mainly diagnosed in childhood or young adulthood, DSM-5 diagnosis being based upon difficulty in two core domains: "persistent deficits in social communication and social interaction across multiple contexts, /---/ restricted, repetitive patterns of behaviors (RRBIs), interests, or activities currently or in history" (APA, 2013). ICD-11 (2020) indicates that expression may vary in presentation and intensity "according to chronological age, verbal and intellectual ability, and disorder severity". Social difficulties from atypical communication i.e. failure to initiate or respond to social contact, atypical nonverbal communication and difficulties in context specific situations; and RRBI's, characterized but not limited to, lack of adaptability, inflexible need for specific routines, excessive adherence to rules, preoccupation with patterns of behavior, special interests, different stimuli; repetitive and stereotyped motor movements common in early childhood also lifelong hyper- or hyposensitivity to different sensory stimuli (ICD-11, 2020). Identity-first ("autistic people") language is used throughout the paper as it is the preference of autistic community (Milton, 2012).

Current evidence suggests an over-representation of males with ca 4:1 ratio, lowering to 2:1 with co-morbid intellectual disability (ID, Loomes et al., 2017; Van Wijngaarden-Cremers et al., 2014) and increases to 9-10:1 (Fombonne, 2009) with less noticeable difficulties. Girls require more severe symptoms for a diagnosis (Kreiser & White, 2014) and are shown to be diagnosed later among children with Asperger syndrome and PDD-NOS (Begeer et al., 2013), suggesting that without co-occurring problems females might not be noticed as easily. There are mainly two not mutually exclusive hypotheses trying to explain differences in diagnosis ratios: the "female protective effect" stating that genetic and environmental risk factors needed for females to develop autism are greater than in males (Robinson, et al., 2013) and the different set

of behavioral symptoms hypothesis, implying that autistic-like traits are better captured in males than females particularly without accompanying ID and/or additional behavioral problems (Allely, 2019; Kopp & Gillberg, 2011).

Behavioral comparisons have shown few significant social and communication impairments between males and females, but latter show less RRBIs and a tendency for "camouflaging" by masking their social difficulties through imitation and observation (Allely, 2019). Some characteristics of female autism phenotype include females' better understanding of the need for social interaction (Bargiela et al., 2016), desire for contact with others, bullying in middle school, better imagination skills, and presence of fewer RRBIs and/or the existing ones concerning more people than objects, thus being less recognized (Young et al., 2018).

**Instruments for adaptation and validation**

Current instruments for adults can be divided into diagnostic and screening tools, as well as self-report or clinician administered. To focus on self-report screening tools for adults without ID we excluded diagnostic and clinician administered measures (Baron-Cohen et al., 2005; Grodberg et al., 2014; Lord et al, 2000; Lord et al., 2012; Nylander & Gillberg, 2001; Ritvo et al., 2011), measures with age range too narrow or not specified (Gilliam, 2014; Gillberg et al., 2001) with lack of research on populations without accompanying ID (Rutter et al., 2003), and validation without adult populations (Baghdadli et al., 2017).

There are five self-report screening instruments: Sensory Reactivity in Autism Spectrum (Elwin et al., 2016), Adult Social Behavior Questionnaire (Horwitz et al., 2016), Social Responsiveness Scale 2nd edition-Adult form (SRS-A; Constantino & Gruber, 2012), RAADS-14 Screen (Eriksson et al., 2013), Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2001) and short forms of them: AQ-10, AQ-S/AQ-28, AQ-20, AQ-39, SRS2-AS30 and SRS2-AS11 (Baghdadli et al., 2017). NICE guidelines recommend AQ-10 as a screening tool for adults and for people without ID either AAA (incl. AQ), ADI-R, ADOS-G, ASDI or RAADS-R as an aid for more comprehensive assessment (NICE, 2012). A systematic review found that only AQ and RAADS-R alongside with their short forms AQ-S and RAADS-14 had psychometric properties with satisfactory or intermediate values and none of the gold standard instruments for children had satisfactory measurement properties for use in adult population (Baghdadli et al., 2017).

**The Autism Spectrum Quotient (AQ,** Baron-Cohen et al., 2001)

AQ is a 50 item self-report questionnaire with unidimensional five-factor structure, designed for adults without accompanying ID, used for screening, and assessing autistic traits in the general population, theorizing that behaviors related to autism lie on a continuum being thus constructed to offer a continuous measure of autistic traits, so the presence of a high score can aid as a screening tool (Baron-Cohen et al., 2001). AQ was developed based on observations of autistic people, items representing the triad of diagnostic impairments (deficits in communication and reciprocity, RRBIs) also autism-related cognitive styles and preferences, assessing five domains: Social Skills, Attention Switching, Attention to Detail, Communication, and Imagination, with ten questions each, around half of the items reversed and preferences instead of behaviors were asked to judge thus preventing false negatives (Baron-Cohen et al., 2001).

Subscales have moderate to high internal consistencies ranging from .63 for Attention to Detail, .65 for both Communication and Imagination, .67 for Attention Switching to .77 for Social Skill, test-retest reliability was good (*r* = .70, Baron-Cohen et al., 2011). Factor structure has varied in different studies from two (Hoekstra et al., 2008, Hoekstra et al., 2011) three (Austin, 2005; Hurst et al., 2007; Palmer et al., 2015), four (Saito et al., 2014; Stewart & Austin, 2009) and five (Kloosterman et al., 2011; Zhang et al., 2016) factors. AQ has good screening properties and differentiates between Asperger's syndrome/high functioning autism (Woodbury-Smith et al., 2005). Original paper used binary scoring (Baron-Cohen et al., 2001), but it has been found that Likert-type scoring is preferrable, yielding higher internal consistency and test-retest reliability (Austin, 2005; Stevenson & Hart, 2017; Zhang et al., 2016). Murray et al. (2016) compared two types of scoring in an item response theory analysis and found the Likert-type scoring to be more informative.

A recent paper found that although AQ was somewhat better at discriminating and predicting autism on a sample of 92 diagnosed adults compared to SRS-A, the predictive values were lower than those gathered from general population studies (Bezemer et al., 2020). Also, in the review of 18 articles none of them provided full data concerning content validity; mixed values for convergent validity from high correlation with SRS2-AS, to very low with ADI-R; and unconfirmed structural validity (Baghdadli et al., 2017). It was also brought out that "[v]alues related to diagnostic data were variable, with significant risks of bias and/or concerns about applicability, and small sample sizes: accuracy ranged from 0.72 to 0.90, AUC from 0.647 to 0.99, sensitivity from 0.75 to 0.95, and specificity 0.52 to 0.97" (Baghdadli et al., 2017).

Ashwood et al. (2016) paper sheds doubt concerning the NICE guideline recommendations as more than half of scores below AQ cut-off were false negatives and generalized anxiety disorder can inflate AQ scores, leading to false positives. Despite that AQ is widely used in research and clinical settings also in experimental studies i.e., with emotion regulation, internalizing disorders, personality correlates, as a measure of autism or autistic traits in general population (Albantakis, 2020; Austin, 2005; Samson et al., 2012).

**The Camouflaging Autistic Traits Questionnaire** (**CAT-Q**; Hull et al., 2019)

CAT-Q is a 25-item self-report questionnaire, created based on reported experiences, behaviors, strategies, and intentions of autistic individuals camouflaging their autism as well as the experiences of autism experts (clinicians, researchers, autistic adults) as opposed to discrepancy methods; with scoring based on a 7-point Likert-type scale from "Strongly Disagree" to "Strongly Agree" (Hull et al., 2019). It comprises of three factors: Compensation (Cmp, 9 items), strategies for actively compensating difficulties; Masking (Msk, 8 items), strategies for hiding autistic features; and Assimilation (Asm, 8 items), strategies for fitting in in social situations, the first two representing the core components of camouflaging: "compensation (i.e. finding ways around the social and communication difficulties associated with autism), and masking (i.e. hiding aspects of one's autistic presentation, or presenting a non-autistic persona to others)" (Hull et al., 2019).

Hull et al. (2020) have also demonstrated sex differences, with higher Msk and Asm scores in females. Cronbach's alpha for total score was .94, Cmp subscale .92, Msk .86 and Asm .93, three-month test-retest had good stability total score r = .77, Cmp .78, Msk .70, and Asm .73. van der Putten et al. (2021) poster had alphas of .75 - .93. Cassidy et al. (2020) found slightly lower rhos from .40 to .83, also correlations with AQ-Short (Hoekstra et al., 2011) total score from .31 to .59, noteworthy was a high correlation (.55) between Cmp and general anxiety. Generalized and social anxiety, exhaustion and depressive symptoms have been associated with camouflaging (Hull et al., 2017; Lai et al., 2017) and higher scores in women (Bargiela et al., 2016), yet not always (Hull et al., 2021). Validity was assessed with correlations of measures of autistic traits (BAPQ), where interestingly Msk had no correlation with autistic traits in the autistic subsample, although the measures correlated in non-autistic subsample, also camouflaging in autistic subsample was not correlated with wellbeing, except for Asm subscale, and social anxiety correlation was .44 with CAT-Q total score among autistic subsample and .60 among non-autistic subsample (Hull et al., 2019).

Fombonne (2020) has pointed out several methodological bottlenecks in camouflaging studies in a recent editorial, like the possible confounding effect of social anxiety (Hull et al., 2021; Jorgenson et al., 2020) but results are mixed, as one paper showed no association with social phobia (Schuck et al., 2019). Lack of systematic samples, unknown representativeness and limited generalizability, unverified diagnosis of autism in participants, inconstant inclusion of nonautistic control group, lack of research on male camouflaging strategies, lack of specific measurements of adult psychopathology, lack of confirmed quantitative associations with lesser well-being, increased depression, or anxiety are some of the issues also brought out (Fombonne, 2020), that need to be considered.

**Co-morbid disorders**

Up to 70% of autistic adults have co-morbid psychiatric disorders (Lai et al., 2011), on average three co-morbid disorders, with highest lifetime prevalence of **depression** (77%), **ADHD** (68%) and **anxiety disorders** (59%, incl. social phobia in all the "higher functioning" participants), also the 25% prevalence of **OCD** (Joshi et al., 2013) was notable. Similar results have been found among hospitalized patients where nearly half of the patients with autism had a previous diagnosis of major depressive disorder, co-morbid ADHD was present in 37% (82% with inattentive subtype), 23% had been previously diagnosed with OCD, common disorders were also social phobia, *anorexia nervosa* and in females – borderline personality disorder (Rydén & Bejerot, 2008). Dell'Osso et al. (2015) suggest that ruminative thoughts, characteristic to depression, might arise from possibly traumatic situations due to autism specific difficulties in expression (of empathy), difficulties in social domain incl. understanding of social codes, certain social naïveté, especially when trauma might be experienced in social setting reducing support, preventing reporting the traumatic experiences, or even understanding the event as being traumatic.

Haruvi-Lamdan and colleagues (2018, 2020) found that autistic people, especially women, were significantly more exposed to traumatic events incl. negative social events, and 61% chose latter (e.g. bullying, verbal insults, humiliations, social exclusion, physical violence) as the most distressing experience, revealing the centrality of social situations as stressors that might be cumulative and chronic by nature. This connection might possibly explain the high prevalence of anxiety among autistic population. Kerns et al. (2015) also point out that traumatic events might cause emotional difficulties and suffering for autistic people, concluding that social and communication deficits, overlap of anxiety and autistic symptoms, and potentially atypical

manifestation of symptoms that are often assessed from observer perspective (parent, specialist) make assessment difficult and even more so, if difficulties are hidden.

**Current work: aims and hypotheses**

Assessing and diagnosing adults with suspected autism spectrum disorder is difficult as the manifestation of core difficulties might be concealed or somewhat different, based on probable sex differences. To do any research in the given area we need adequate instruments to assist clinicians at first in screening and afterwards establishing a diagnosis, if needed. Also, considering sex differences in autism and budding research in the given area an instrument measuring camouflaging (CAT-Q, Hull et al., 2019), might add valuable information. Thus, the current study has two aims – to adapt into Estonian AQ and CAT-Q and explore how sex and anxiety level influence the manifestation of autistic traits. From these aims the following hypotheses were established:

**H1:** Autism Spectrum Quotient (AQ) will probably range between 3-5 meaningful factors.

**H2:** Camouflaging Autistic Traits Questionnaire (CAT-Q) will probably retain the Masking, Compensation and Assimilation factors found in the original paper.

**H3:** For convergent validity significantly higher positive correlations between total and subscale sores of questionnaires measuring autistic traits (AQ, CAT-Q) will be expected (***H3a***) and for discriminant validity lower positive correlations with EST-Q2 depression, anxiety, and fatigue subscales, OCI-R total score, SPAI total and differential score, ADHD total and subscale scores will be expected (***H3b***).

**H4:** Total and subscale scores of questionnaires measuring autistic traits (AQ, CAT-Q) will differ significantly between non-autistic, close relative with autism, self-diagnosed autistic and diagnosed autistic groups, (***H4a***), between sexes (***H4b***), and reveal group and sex interactions (***H4c***) even when general anxiety (EST-Q2, ANX) or social anxiety (SPAI) scores are held constant (***H4d***).

Author of the present study planned the research and wrote the ethics committee proposal, both with the support of the supervisor, contributed by testing among patients, oversaw the translation and adaptation process, also being the first translator of the original items into Estonian; collected, scored, and analyzed the data, and wrote the master’s thesis.

# Method

## Procedure

Research protocol was approved by the Ethic Committee of the University of Tartu (327/T-23). Web survey advertisement was shared via Facebook and appropriate mailing lists, also by autistic self-representation organizations. Clinical sample is comprised of Astangu Vocational Rehabilitation Centre students and psychology clinic clients with self-confirmed autism diagnosis willing to take part in the study. Informed consent was obtained before filling out questionnaires, all participants were able to quit the survey at any point. Exclusion criteria were not in the age range of 18-69 years, self-reported mental retardation (IQ < 70; confirmed with informed consent, education level, word usage and length of the study), restricted active legal capacity, and refusal to participate in the study. Data was gathered from Nov. 2020 to Feb. 2021.

Survey comprised of demographic data, 3 questionnaires measuring autistic traits: Autism Spectrum Quotient, Empathy Quotient (not used currently), and the Camouflaging Autistic Traits-Questionnaire; the Emotional State Questionnaire-2, Adult ADHD Self-Report Scale-V1.1 Screener, Social Phobia and Anxiety Inventory, the Obsessive-Compulsive Inventory—Revised, Estonian versions of the Posttraumatic Stress Disorder Checklist—Civilian version and Difficulties in Emotion Regulation Scale (latter two not used currently). Students ($n$ = 19) received research participation credit upon wish, all other survey completers were offered the chance to win 4x25 euros worth of gift certificates when they left their e-mails into another anonymous survey created for that aim.

## Translation and adaptation process of AQ and CAT-Q into Estonian

Forward translation of the questionnaires was done by three different English and Estonian proficient specialist in the field of psychology. Translations were compared for discrepancies in meaning incl. idioms, expressions, word usage and concepts. After agreeing upon the best options questionnaires were piloted ($n$ = 10) among autistic community (self-, medical diagnosis) and general population (incl. medical students) with participants filling out the questionnaires, commenting the understandability of each item and suggesting improvements, clarifying meanings, word usage, offering alternative or complementary wordings and questions. After reviewing suggestions, the questionnaires were back translated by a professional translator and compared by the author of this work to the original questionnaires. The idioms were translated for meaning. Additional questions were added to CAT-Q to tap possible population

specific difficulties, which is in accordance with the creation method of CAT-Q where autistic people informed researchers about their difficulties (Hull et al., 2019). Permissions to adapt and validate AQ, EQ and CAT-Q have been granted by the authors.

## Measures

Autism Spectrum Quotient (Baron-Cohen et al., 2001) and Camouflaging Autistic Traits-Questionnaire (Hull et al., 2019) have been described thoroughly in the introduction.

**Emotional State Questionnaire** (**EST-Q2**; Aluoja et al., 1999; Ööpik et al., 2006) is a widely used 28-item self-report screening test with five subscales (Depression, Anxiety, Agoraphobia-Panic, Fatigue, and Insomnia) reflecting symptoms of depressive and anxiety disorders consistent with ICD-10 and DSM-IV. Items were rated concerning how much various problems troubled participants during the previous month on a 5-point frequency scale ranging from 0 (not at all) to 4 (all the time). A total of 569 participants completed EST-Q2, with internal consistencies of .95, .91, .91, .86 for Total, Depression, Fatigue and Anxiety scales, respectively.

**Adult ADHD Self-Report Scale-V1.1 (ASRS-V1.1) Screener** (Kessler et al., 2005) is a DSM-IV-TR criteria based 6-item subset that best predicted adult ADHD from the 18-item Screener. Respondents had to assess how often during the last 6 months a specific symptom of ADHD occurred on a 5-point Likert type scale from 0 = Never to 4 = Very Often with first three assessing Inattentive (IA) symptoms and latter Hyperactivity-Impulsivity (H-I) symptoms (Kessler et al., 2007). Continuous scoring was used. 518 participants completed the screener, with internal consistencies of .81, .75 and .69, respectively for Total, IA and H-I scales.

**Social Phobia and Anxiety Inventory** (**SPAI**; Turner et al., 1989, Estonian version Jakobi 2003) is a short 23-item self-report measure of social phobia, with Social Phobia and Agoraphobia subscales, Items are rated on a 7-point Likert type scale from 0 = Never to 6 = Always. A total of 505 participants completed SPAI, with excellent (α=.97) internal consistency.

**The Obsessive-Compulsive Inventory—Revised** (**OCI-R**, Foa et al., 2002) is an 18-item short version self-report questionnaire with 6 subscales (Washing, Checking, Obsessing, Neutralizing, Ordering, Hoarding) currently being adapted into Estonian (E-OCI-R; Säde, 2021), Respondents marked how much the experiences described on the 18 items have distressed or bothered them during the past month on a 5-point Likert type scale from 0 = Not at all to 4 = Extremely. A total of 502 participants completed E-OCI-R with a Total score alpha of .91.

**Data Analysis**

All the analyses, if not stated otherwise, were conducted with SPSS version 23.0. Parallel analysis was done with RStudio 3.6.1 (RStudio Team, 2020) using package "psych" (Revelle & Revelle, 2015). For descriptive statistics Fisher's exact test was used to compare groups as there were groups with few participants, effect size was calculated with Cramer's V. Age comparisons were calculated with one-way ANOVA. All analyses, where possible, were controlled using non-parametric alternatives (either Kruskal-Wallis H with *post hoc* Dunn-Bonferroni test and Bonferroni correction if necessary or Mann Whitney U test) when results differed, it was brought out. Based on the sample sizes and descriptive statistics I created four groups: diagnosed autistic group, comprising of clinical sample and people with self-reported diagnosed autism spectrum disorder (**Diagnosis**), autistic close relative group (**Phenotype**), self-diagnosed autistic group (**Self-suspected**), and **Controls**. Respondents had the possibility of agreeing with multiple options, so if both self-suspected and close relative with autism were endorsed, they were added to the latter group.

Respondents with more than five values missing from a questionnaire were excluded and other missing responses were substituted with mean item response following previous work (e.g., Hoekstra et al., 2011, Stevenson & Hart., 2017). Likert-type scoring was used in AQ instead of dichotomous (Baron-Cohen et al., 2001) as the reliable range of measurement was shown to be thus improved (Austin, 2005; Murray, et al., 2016; Saito et al., 2014; Stevenson & Hart, 2017). Principal component analysis (PCA) with promax rotation has been predominantly used with AQ (Austin et al., 2005; Hurst et al., 2007), also unweighted least squares with promax rotation (Saito et al., 2014). There are also mixed results concerning AQ factor structure with Kloostermann et al. (2011) found that none of the used factor structures fitted. CAT-Q used PCA with oblique rotation and recently CFA was presented (Hull et al., 2019; van der Putten et al., 2021). Principal axis factoring (PAF) with promax rotation (as PCA assumes no measurement error; Osborne et al., 2014) was used here and not confirmatory factor analysis (CFA) as the aim is to adapt the questionnaires, thus putting more emphasis on the individual items not on the fit of the model.

Sampling adequacy was measured with Keiser-Meier-Olkin (KMO) index, for determining the presence of significant correlations Bartlett test of sphericity was used, multicollinearity diagnostic, correlation matrix determinant (< .0001) was calculated and reported if significant, the number of factors were assessed using Kaiser and Cattell criteria and parallel analysis (Cattell, 1966; Horn, 1965; Kaiser, 1960). Parallel analysis suggestions were tested first

but were disregarded if the number of items with primary factor loadings per factor were < .3 and/or the factor content was illogical, as it has been shown that parallel analysis can sometimes overestimate the number of factors (Hayton et al., 2004). Communalities < .2 were removed (Child, 2006), > .4 were considered acceptable (Osborne et al., 2014). For internal consistency Cronbach's alpha, for construct validity Pearson correlation coefficient (controlled with Spearman rho) and for split-half reliability Spearman-Brown formula were calculated.

Before comparisons between groups variables were examined for normality of distributions and none of the continuous variables displayed excessive skewness or kurtosis, outliers were removed from analyses if necessary. As the assumptions for one and two-way MAN(C)OVA using Pillai's Trace (Tabachnik & Fidell, 2014) with Sidak's correction, were not met, the results if possible were controlled with non-parametric Kruskal-Wallis H test, with *post hoc* Dunn-Bonferroni test and Bonferroni correction.

### Sample demographic data

Total sample consisted of 765 people of whom participants not in the age range of 18-69 were removed ($n = 3$), 150 people did not fill any of the questionnaires and 75 filled only demographic data. Survey was completed by 486 participants and additional clinical sample consisted of 12 participants ($n = 498$; $F = 409$, $M = 89$, see Table 1). A statistically significant association between groups as assessed by Fisher's exact test $p < .0001$, V = .26 was found between participants who reported being single: autism diagnosis (clinical, 75%), autism diagnosis (online, 56.7%), autism self-suspected (29.5%), autistic close relative (17.9%) and control group (23.0%). Also, a statistically significant association between groups as assessed by Fisher's exact test, $p = .004$, V = .18 was found between participants who reported being married or in a long-term partnership: autism diagnosis (clinical, 1.7%), autism diagnosis (online, 3.0%), autism self-suspected (6.0%), autistic close relative (4.6%) and control group (23.0%).

## Results

### Autism Spectrum Quotient Estonian version (AQ-24)

Whole scale (50 + 1 parallel item) KMO index of sampling adequacy was very good (.912), Bartlett's test of sphericity was statistically significant ($\chi^2(1275) = 11291.57$, $p < 0{,}001$). 11 factors had eigenvalue >1, parallel analysis suggested 10 factors and scree plot showed a drop after 4$^{th}$ factor (Fig. 1). After removal of items with communalities less than .2 (items: 21, 42, 35, 24, 28, 30, 40, 48, 49, 39) and factor scores less than .3 (item: 5) 5-factor (cumulative

**Table 1.** *General sample demographics.*

| Variables | | Total sample (*n* = 498) | Autism diagnosis[b] (clinical, *n* = 12) | Autism diagnosis[b] (online, *n* = 30) | Autistic relative (*n* = 95) | Autism self-suspected (*n* = 105) | Controls (*n* = 256) | *p*-value | Effect size |
|---|---|---|---|---|---|---|---|---|---|
| | | *M = (SD) [range]* | | | | | | ANOVA | |
| Mean age (yr-s) | | 36.31 (11.14) [18-67] | 23.33 (6.26) [18-36] | 33.87 (10.20) [19-51] | 41.51 (10.83) [18-65] | 36.07 (10.67) [20-61] | 35.37 (10.91) [18-67] | F(4, 497) = 10.87, $p <$ **.0001** | $\eta^2 = .081$ |
| Mean age (diagnosis) | | | 18.71 (7.09)[a] [11-32] | 29.40 (11.5) [4-51] | | | | F(1, 37) = 5.48, $p =$ **.025** | $\eta^2 = .135$ |
| | | *N (%)* | | | | | | FET | |
| Sex | Male | 89 (17.9) | 9 (1.8) | 7 (1.4) | 6 (1.2) | 30 (6.0) | 37 (7.4) | | |
| | Female | 409 (82.1) | 3 (.6) | 23 (4.6) | 89 (17.9) | 75 (15.1) | 219 (44.0) | < **.0001** | V = .30 |
| | Male : Female | 1:4.6 | 3:1 | 1:3.3 | 1:14.8 | 1:2.5 | 1:5.9 | | |
| Disorder[c] | | 212 (42.6) | 6 (1.2) | 25 (5.0) | 46 (9.2) | 61 (12.2) | 74 (14.9) | < **.0001** | V = .32 |
| **Educational attainment[d]** | | | | | | | | | |
| | Lower secondary | 20 (4.0) | 7 (1.4) | 4 (.8) | 5 (1.0) | 3 (.6) | 1 (.4) | < **.0001** | V = .47 |
| | Secondary | 63 (12.7) | 1 (.2) | 1 (.2) | 13 (2.6) | 19 (3.8) | 29 (5.8) | .218 | V = .11 |
| | Vocational | 59 (5.4) | 1 (.2) | 2 (.4) | 18 (3.6) | 11 (2.2) | 27 (5.4) | .240 | V = .11 |
| | University | 356 (71.5) | 3 (.6) | 23 (4.6) | 59 (11.8) | 72 (14.5) | 199 (40.0) | **.001** | V = .21 |
| **Employment** | | | | | | | | | |
| | Employed[ef] | 364 (73.1) | 5 (1.0) | 13 (2.6) | 68 (13.7) | 76 (15.3) | 202 (40.6) | < **.0001** | V = .22 |
| | Student[eg] | 166 (29.7) | 4 (.8) | 13 (2.6) | 27 (5.4) | 36 (7.2) | 86 (17.3) | .650 | V = .07 |
| | Retired | 11 (2.2) | 0 (.0) | 0 (.0) | 4 (.8) | 1 (.2) | 6 (1.2) | .613 | V = .05 |
| | Work capability[h] | 70 (14.1) | 3 (.6) | 13 (2.6) | 21 (4.2) | 20 (4.0) | 13 (2.6) | < **.0001** | V = .31 |
| | Unemployed | 42 (8.4) | 3 (.6) | 7 (1.4) | 7 (1.4) | 12 (2.4) | 13 (2.6) | **.002** | V = .19 |

*Note.* ANOVA for age; Fisher's exact test for remainder of variables. [a]Age was not reported for 3 participants in the clinical group; [b]autism diagnosis self-reported; [c]Previous/current psychiatric disorder; [d]Highest acquired; [e]full- or part-time, [f]self-employed; [g]distance education; [h]Decreased work capability.
*Abbreviations*: FET, Fisher's Exact test; V, Cramer's V.

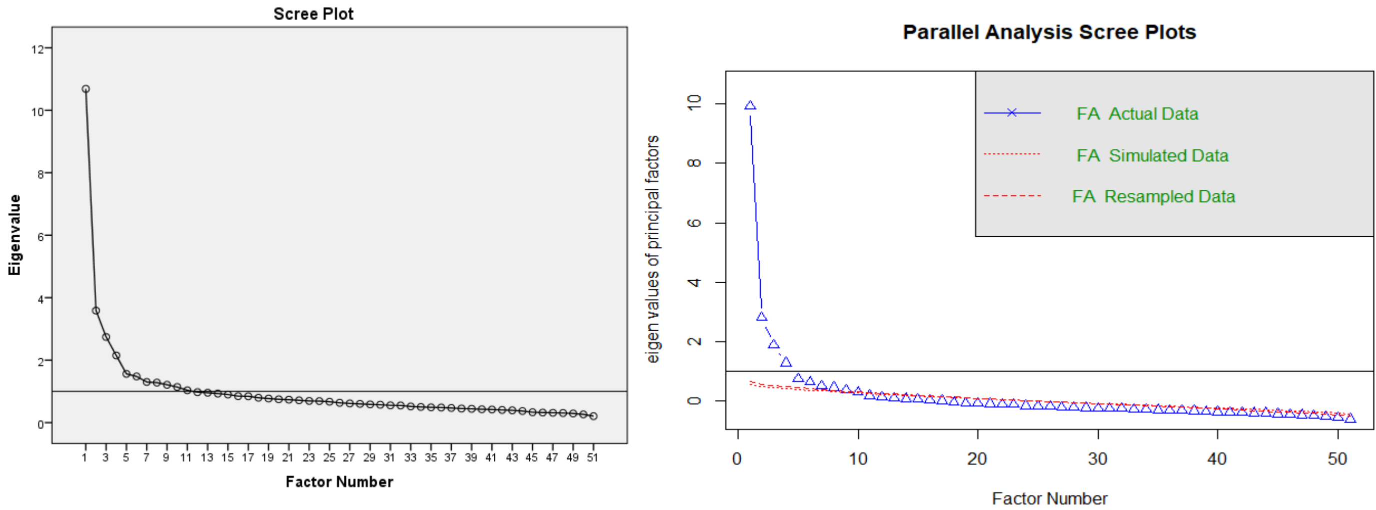


*Figure 1.* Autism Spectrum Questionnaire Estonian version (AQ-24) scree plot, horizontal line is depicting eigenvalue of 1 (left) and parallel analysis scree plots (right), factors' eigenvalues extracted from survey data are indicated with triangles; FA stands for factor analysis.

explanation: 38.86%) and 4-factor (36.40%) solutions with original factors were compared. In the 4-factor solution Attention Switching (AS) factor was merged with Social Skills (SS) factor and as the factors have little in common concerning the underlying latent trait, as well as AS having lower factor loadings, the original five factor solution was retained. Items with factor scores less than .4 were removed if they did not load onto the original factor (items: 16 and its parallel item 51; 41, 37). To achieve more balanced factor structure, items that had factor loadings less than .4 (items: 2, 12, 23, 33, 4), had strong (>.4) factor loadings onto several factors were removed from the first two factors, also looking into inter-item correlations and content to ensure that items would grasp different aspects of the latent factor.

The Estonian version of Autism Spectrum Questionnaire (AQ-24; Table 2) consists of 24 items, with 5 factors, cumulative percentage of variation explained by the factors is 44.2%, individual factors account for 24.12%, 7.48 %, 5.84%, 3.62% and 3.14% of the total variance, respectively. Reliability of the scale is excellent with total scale Cronbach alpha of .86. Spearman-Brown split-half reliability was .89 (items 11, 26, 38, 27, 20, 36, 43, 46, 14, 3, 19, 6 and items 17, 22, 44, 29, 9, 8, 50, 25, 34, 31, 45, 7).

First factor (Social Skills, SS) consists of 6 items, with Cronbach alpha of .86, three of the six items (17, 26, 38) belonged originally to a component measuring communication, but as communication and social skills are interrelated concepts it can be difficult to measure solely one.

Also, two items (36, 45) from the second factor belonged originally to the SS factor. Second factor (Communication/mindreading) consists of 6 items (α = .79). Item 20 (*When I'm reading a story, I find it difficult to work out the characters' intentions*) belonged originally to the Imagination component but seems to be tapping mindreading in both languages as well. Third factor (Attention to Detail) consists of four items (α = .74), fourth factor (Imagination) consists of four items (α = .66) and fifth factor (Attention Switching) consists of four items (α = .69). Correlations between AQ-24 factors are brought out in Table 4. The Estonian versions of the two questionnaires are available upon request.

**Table 2.** *Autism Spectrum Quotient-24 factor structure with factor loadings and communalities*

| Items | F1 | F2 | F3 | F4 | F5 | Com |
|---|---|---|---|---|---|---|
| **Factor 1: Social Skills** | | | | | | |
| 11. I find social situations easy.* | **.86** | .01 | -.03 | .07 | .02 | .79 |
| 17. I enjoy social chit-chat.* | **.81** | -.06 | .04 | -.07 | -.02 | .57 |
| 26. I frequently find that I don't know how to keep a conversation going.* | **.76** | .05 | .00 | .07 | -.13 | .55 |
| 22. I find it hard to make new friends. | **.67** | .15 | -.11 | -.05 | .04 | .57 |
| 38. I am good at social chit-chat.* | **.66** | -.07 | .06 | .09 | -.13 | .36 |
| 44. I enjoy social occasions.* | **.54** | -.08 | .04 | -.03 | .14 | .34 |
| **Factor 2: Communication** | | | | | | |
| 27. I find it easy to "read between the lines" when someone is talking to me.* | .01 | **.76** | -.17 | .04 | .00 | .53 |
| 45. I find it difficult to work out people's intentions. | .10 | **.62** | -.01 | -.09 | -.00 | .44 |
| 20. When I'm reading a story, I find it difficult to work out the characters' intentions. | -.06 | **.60** | .20 | .10 | -.05 | .47 |
| 31. I know how to tell if someone listening to me is getting bored.* | -.11 | **.59** | -.02 | .09 | .06 | .33 |
| 36. I find it easy to work out what someone is thinking or feeling just by looking at their face.* | -.01 | **.58** | -.03 | .10 | .03 | .37 |
| 7. Other people frequently tell me that what I've said is impolite, even though I think it is polite. | .11 | **.50** | .13 | -.20 | .01 | .39 |
| **Factor 3: Attention to Detail** | | | | | | |
| 19. I am fascinated by numbers. | .05 | .01 | **.77** | .04 | -.06 | .59 |
| 9. I am fascinated by dates. | -.03 | .04 | **.75** | .01 | .05 | .59 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6. I usually notice car number plates or similar strings of information. | .09 | .04 | **.58** | -.10 | .05 | .42 |
| 29. I am not very good at remembering phone numbers.* | -.07 | -.11 | **.51** | .12 | .01 | .22 |
| **Factor 4: Imagination** | | | | | | |
| 14. I find making up stories easy.* | .04 | -.15 | .05 | **.65** | .08 | .41 |
| 8. When I'm reading a story, I can easily imagine what the characters might look like.* | -.02 | .19 | -.03 | **.62** | -.10 | .50 |
| 3. If I try to imagine something, I find it very easy to create a picture in my mind.* | .02 | .08 | .03 | **.57** | -.04 | .35 |
| 50. I find it very easy to play games with children that involve pretending.* | .05 | .04 | .05 | **.38** | .15 | .21 |
| **Factor 5: Attention Switching** | | | | | | |
| 43. I like to plan any activities I participate in carefully. | -.18 | .04 | .05 | -.06 | **.64** | .34 |
| 25. It does not upset me if my daily routine is disturbed.* | .08 | .08 | .04 | -.03 | **.62** | .51 |
| 34. I enjoy doing things spontaneously.* | .05 | -.07 | -.04 | .19 | **.57** | .36 |
| 46. New situations make me anxious. | **.31** | .05 | -.04 | -.03 | **.42** | .44 |
| **Variance explained (%)** | 24.12 | 7.48 | 5.84 | 3.62 | 3.14 | |
| **Cronbach's alpha** | .86 | .79 | .74 | .66 | .69 | |

*Note:* Principal axis factoring; oblique (promax) rotation with Kaiser normalization. Factor loadings > .30 are in boldface. $N$ =582. F1 = Social Skills; F2 = Communication; F3 = Attention to Detail; F4 = Imagination; F5 = Attention Switching; Com = communalities. *reverse coded item.

**Camouflaging Autistic Traits-Questionnaire Estonian version (CAT-Q-25)**

CAT-Q-25 item pool consisted of 25 original items, nine added items and two parallel items (31, 32) to item 12 (*I don't feel the need to make eye contact with other people if I don't want to*) to remove double negation were added. Added items were based on recommendations from autistics who filled the questionnaire during pilot, in line with the theoretical basis of the original scale (Hull et al., 2019). KMO index of sampling adequacy was very good (.950), Bartlett's test of sphericity was statistically significant ($\chi^2(630) = 11935.91$ $p < .001$). For the analyses, the whole item pool of 36 was used and it was attempted to retain as much original items as possible. Six factors had eigenvalue >1, parallel analysis also suggested six factors and scree plot showed a drop between 3$^{rd}$ and 4$^{th}$ factor (Fig. 2). Finally, the three-factor solution was used.

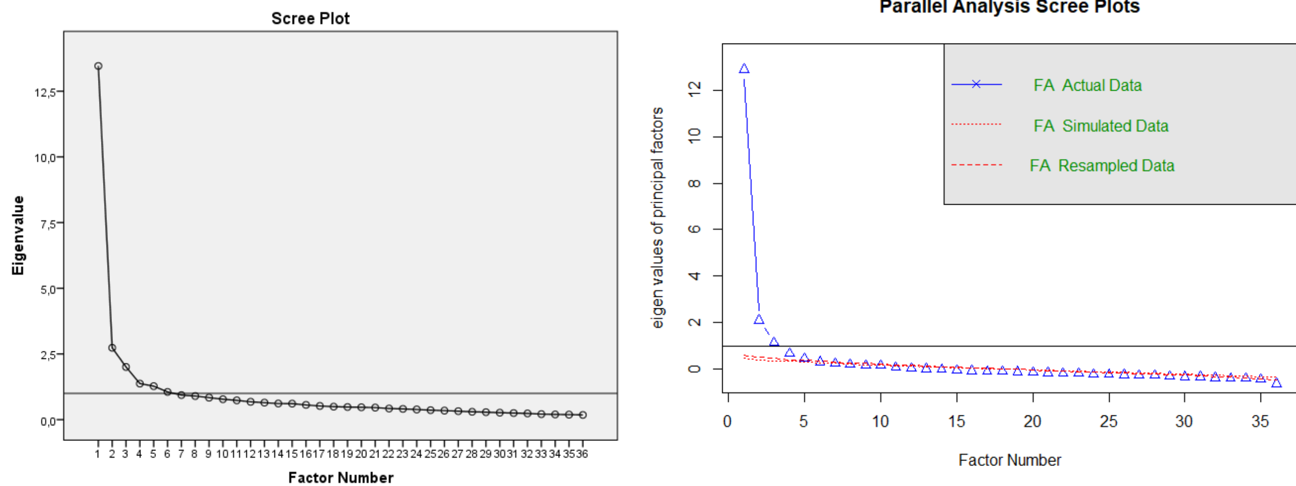


***Figure 2.*** Camouflaging Autistic Traits-Questionnaire Estonian version (CAT-Q-25) scree plot, horizontal line depicting eigenvalue 1 (left) and parallel analysis scree plots (right), factors' eigenvalues extracted from survey data are indicated with triangles; FA stands for factor analysis.

Five items (3, 12, 18, 24, 29) had communalities less than .2 so they were removed. Remaining 29 items loaded mostly on the original factors, except item 1 (*When I am interacting with someone, I deliberately copy their body language or facial expressions*) that loaded onto Masking instead of Compensation. Factors had thus 10, 9 and 8 items, respectively. Items 5, 8 and 30 had cross loadings of at least .3, items 5 and 8 had factor loadings less than .4 (.33 and .35 respectively) and item 33 had communality less than .3. Items 5 and 33 were removed, and decision was made to retain item 8 due to content and to retain as much original scale items as possible and item 30 due to content. Final version of the scale has 25 items, of which five are newly created (items 26, 28, 30, 34, 36). Factors retained their original names: Assimilation (F1), Compensation (F2) and Masking (F3), Cronbach's alphas were in the range of .87-.93 and the proportion of variance explained was 44.78%, 7.59%, and 3.71%, respectively (Table 3). Total variance explained was 56.08% and total scale Cronbach's alpha was excellent (.95). Spearman Brown split-half reliability was .96 (items 19, 16, 13, 25, 36, 23, 28, 14, 30, 6, 2, 9, 8 and items 1, 15, 21, 20, 17, 11, 4, 22, 10, 7, 26, 34).

The 25-item scale correlation matrix determinant is $7.19 \times 10^{-8} < .0001$ revealing problems with multicollinearity. Removing highly correlated (more than three .6 correlations with other items) items means removing the items 21, 22, 23 among others and thus the scale could lose possibly useful information. Currently multicollinearity might make the whole scale unstable, so one must exert caution to interpret the information in the following analyses.

**Table 3.** *Camouflaging Autistic Traits-Questionnaire Estonian version (CAT-Q-25) factor structure with factor loadings and communalities*

| Items | F1 | F2 | F3 | Com |
|---|---|---|---|---|
| **Factor 1: Assimilation** | | | | |
| 19. I feel free to be myself when I am with other people* | **.90** | -.15 | -.01 | .65 |
| 22. When talking to other people, I feel like the conversation flows naturally* | **.88** | -.02 | -.17 | .62 |
| 16. When in social situations, I try to find ways to avoid interacting with others | **.86** | .04 | -.15 | .65 |
| 10. I need the support of other people in order to socialise | **.75** | -.03 | -.01 | .53 |
| 25. In social situations, I feel like I am pretending to be 'normal' | **.73** | .11 | .07 | .71 |
| 7. In social situations, I feel like I'm 'performing' rather than being myself | **.72** | -.04 | *.21* | .68 |
| 13. I have to force myself to interact with people when I am in social situations | **.63** | -.06 | .17 | .48 |
| 26. After excessive social interactions I experience great deal of physical and mental exhaustion ("social hangover") and recuperation might take several days[a] | **.59** | *.26* | -.11 | .52 |
| 36. I have kept myself back when talking about topics I am deeply interested about or avoided them altogether, from the fear of negative reaction of others[a] | **.58** | .03 | .09 | .43 |
| 34. Before going to a social situation, I have to picture how thing might turn out (think through the possible negative variants)[a] | **.56** | .16 | .06 | .51 |
| **Factor 2: Compensation** | | | | |
| 23. I have spent time learning social skills from television shows and films, and try to use these in my interactions | -.07 | **.96** | -.07 | .76 |
| 20. I learn how people use their bodies and faces to interact by watching television or films, or by reading fiction | -.16 | **.81** | .08 | .60 |
| 28. I have knowingly learnt (for example by observing others, from reading books, watching television, using Internet) words that describe my feelings or emotions[a] | .10 | **.78** | -.13 | .57 |

| | | | | |
|---|---|---|---|---|
| 17. I have researched the rules of social interactions (for example, by studying psychology or reading books on human behaviour) to improve my own social skills | -.12 | **.57** | .19 | .41 |
| 14. I have tried to improve my understanding of social skills by watching other people | .14 | **.55** | .18 | .62 |
| 11. I practice my facial expressions and body language to make sure they look natural | *.20* | **.54** | .07 | .54 |
| 30. I have changed calming or focusing inducing activities more socially acceptable (i.e. twirling a pencil, hair etc, moving my leg, touching a rock in my pocket)[a] | **.32** | **.46** | -.04 | .47 |
| 4. I have developed a script to follow in social situations (for example, a list of questions or topics of conversation) | *.23* | **.41** | .12 | .46 |
| **Factor 3: Masking** | | | | |
| 6. I adjust my body language or facial expressions so that I appear interested by the person I am interacting with | -.09 | -.07 | **.92** | .68 |
| 15. I monitor my body language or facial expressions so that I appear interested by the person I am interacting with | -.02 | .04 | **.85** | .74 |
| 2. I monitor my body language or facial expressions so that I appear relaxed | -.10 | .18 | **.62** | .49 |
| 21. I adjust my body language or facial expressions so that I appear relaxed | .01 | *.27* | **.59** | .65 |
| 9. I always think about the impression I make on other people | **.38** | *-.27* | **.48** | .35 |
| 1. When I am interacting with someone, I deliberately copy their body language or facial expressions | .02 | .09 | **.48** | .31 |
| 8. In my own social interactions, I use behaviours that I have learned from watching other people interacting | *.22* | **.33** | **.33** | .59 |
| **Variance explained (%)** | 44.78 | 7.59 | 3.71 | |
| **Cronbach's alpha** | .93 | .90 | .87 | |

*Note:* Principal axis factoring; oblique (promax) rotation with Kaiser normalization. Factor loadings > .30 are in boldface. [a]Item is created by the author of this work based on suggestions from Estonian autistic community, raw translation onto English. *N* = 581. F1 = Assimilation; F2 = Compensation; F3 = Masking; Com = communalities. *reverse coded item.

**Construct validity**

Correlations between CAT-Q-25 subscales moderate to strong (.63-.73, $p < .001$), implying that although subscales are related, they measure different aspects of camouflaging. It is worth noticing that high correlations in camouflaging subscales might be indicative of multicollinearity, discussed previously. Correlations between AQ-24 subscales ranged from negligible to moderate (.06 to .51, $p < .001$) yet were correlated moderately to strongly (.47-.80, $p < .001$) with total scale implying that, these might measure uncorrelated facets of autism like Attention Switching (AS), Attention to Details (AtD) and Imagination (Img). Stronger correlations between Communication (Com) and Social Skills (SS) factors are due to the social content of the factors, which might influence the correlations of AS, AtD and Img with SS and Com, ie "*New situations make me anxious*" from Img subscale has a factor loading of .31 to SS factor too, and might thus be the reason between their .26 correlation.

**Table 4.** *Pearson correlations between Estonian versions of Autism Spectrum Quotient, Empathy Quotient and Camouflaging Autistic Traits-Questionnaire total scores and subscale scores.*

| | **AQ-24** | | | | | | **CAT-Q-25** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Total** | **AS** | **Img** | **AtD** | **Com** | **SS** | **Total** | **Asm** | **Cmp** | **Msk** |
| **AQ24 Total** | 1 | | | | | | | | | |
| **AS** | .67** | 1 | | | | | | | | |
| **Img** | .47** | .16** | 1 | | | | | | | |
| **AtD** | .51** | .19** | .06 | 1 | | | | | | |
| **Com** | .79** | .38** | .26** | .33** | 1 | | | | | |
| **SS** | .80** | .50** | .26** | .18** | .51** | 1 | | | | |
| **CATQ Total** | .68** | .54** | .11** | .32** | .56** | .62** | 1 | | | |
| **Asm** | .76** | .58** | .17** | .29** | .59** | .77** | .90** | 1 | | |
| **Cmp** | .55** | .43** | .08 | .31** | .52** | .43** | .90** | .69** | 1 | |
| **Msk** | .40** | .37** | .02 | .24** | .33** | .34** | .85** | .63** | .73** | 1 |

*Note*. Pearson point biserial correlations. Abbreviations: AQ-24, Autism Spectrum Quotient-24; AS, Attention Switching subscale; Img, Imagination subscale; AtD, Attention to Details subscale; Com, Communication subscale; SS, Social Skills subscale; CAT-Q-25, Camouflaging Autistic Traits Questionnaire-25; Asm, Assimilation subscale; Cmp, Compensation subscale; Msk, Masking subscale. *$p < .05$ (two-tailed). **$p < .001$ (two-tailed).

Correlations between AQ-24 and CAT-Q-25 remain in the range of .24-.77 ($p < .001$), apart from AQ-24 Img subscale n.s. correlations .02-.08 with Compensation (Cmp) and Masking

(Msk) subscales and .17 ($p < .001$) correlation with Assimilation (Asm) subscale – indicating that Img is an unrelated construct concerning camouflaging. CAT-Q-25 Cmp and Msk subscales are moderately correlated with AQ-24 total and subscales (.33-.55, $p < .001$), but Asm shows higher correlations with AQ-24 total (.76) and SS (.77) scales, possibly indicating that autistics with higher social awareness are more prone to use assimilation-related behaviors.

AQ-24 and CAT-Q-25 correlations with instruments screening depression, anxiety, mental fatigue, ADHD, OCD, and social anxiety (Table 5) show mostly lower correlations between total and subscale scores, yet not without exceptions. Anxiety correlations (both social and general anxiety) with AQ-24 and CAT-Q-25 total scores and sociability related subscales are mostly moderate to strong, indicating that as previously found, anxiety might exacerbate the expression of autistic traits in questionnaires (Ashwood et al., 2016; Hull et al., 2017; Hull et al., 2021). ADHD is a closely related concept, which is reflected in the correlations.

**Table 5.** *Estonian versions of Autism Spectrum Quotient and Camouflaging Autistic Traits Questionnaire total and subscale correlations with screening tests measuring related constructs.*

| | **EST-Q2** | | | **OCI-R** | **ADHD** | | | **SPAI** | |
|---|---|---|---|---|---|---|---|---|---|
| | DEP | ANX | FAT | total | Total | IA | H-I | Total | Dif |
| **AQ-24** | | | | | | | | | |
| Total | .47** | .47** | .37** | .53** | .41** | .33** | .41** | .64** | .50** |
| AS | .40** | .48** | .35** | .45** | .28** | .19** | .31** | .57** | .48** |
| Img | .04 | .08 | .04 | .12**[,n.s] | .13* | .11*[,n.s] | .13* | .23** | .24** |
| AtD | .18** | .17** | .13** | .33** | .13* | .07 | .16** | .22** | .08[a,*] |
| Com | .37** | .37** | .28** | .45** | .41** | .35** | .38** | .43** | .27** |
| SS | .47** | .41** | .36** | .40** | 36** | .32** | .33** | .64** | .56** |
| **CAT-Q-25** | | | | | | | | | |
| Total | .55** | .55** | .50** | .57** | .52** | .43** | .51** | .67** | .51** |
| Asm | .63** | .59** | .55** | .59** | .53** | .44** | .52** | .76** | .62** |
| Cmp | .41** | .43** | .39** | .50** | .43** | .35** | .43** | .50** | .31** |
| Msk | .36** | .39** | .36** | .36** | .39** | .31** | .40** | .46** | .37** |

*Note*. Pearson point biserial correlations. Abbreviations: AQ-24, Autism Spectrum Quotient-24; AS, Attention Switching subscale; Img, Imagination subscale; AtD, Attention to Details subscale; Com, Communication subscale; SS, Social Skills subscale; CAT-Q-25, Camouflaging Autistic Traits Questionnaire-25; Asm, Assimilation subscale; Cmp, Compensation subscale; Msk, Masking subscale; EST-Q2, Emotional State Questionnaire-2; DEP, Depression subscale; ANX, Anxiety subscale; FAT, Fatigue subscale; ADHD, ASRS-V1.1 Screener; H-I, Hyperactivity-

Impulsivity subscale; IA, inattentive subscale; SPAI, Social Phobia and Anxiety Inventory; SPAI dif, social phobia differential score; OCI-R, Obsessive-Compulsive Inventory—Revised. [n.s]Non-significant when controlled with Spearman rho; [a]Significant when controlled with Spearman rho. *$p$ < .05 (two-tailed). **$p$ < .001 (two-tailed).

Conclusively, with some expected exceptions, questionnaires measuring autistic traits are more highly correlated between themselves, indicating higher convergent validity and with smaller correlations between screening tests measuring related, yet distinct difficulties.

## Group and sex main effects

In Diagnosis (Dgn), Self-suspected (SelfS), Phenotype (Phn) and Control (Cnt) groups statistically significant effects emerged in all the AQ-24 and CAT-Q-25 total and subscale scores (Table 6). **AQ-24** total score (F(3,528) = 86.49, $p < .0001$, $\eta^2 = .331$) and all the subscales: AS (F(3,528) = 32.89, $p < .0001$, $\eta^2 = .158$), Img (F(3,528) = 7.18, $p < .0001$, $\eta^2 = .039$), AtD (F(3,528) = 12.95, $p < .0001$, $\eta^2 = .069$), Com (F(3,528) = 67.92, $p < .0001$, $\eta^2 = .280$) and SS (F(3,528) = 58.27, $p < .0001$, $\eta^2 = .250$) differ groupwise statistically significantly (Table 6). All the groups differed significantly from Controls on AQ total, AS, SS and Com scores except for Img subscale score, that differed only between Dgn (M = 9.98, SD = 2.60) and Cnt (M = 8.28, SD = 2.49). AtD score differed between Cnt (M = 8.39, SD = 2.97) and Dgn (M = 10.27, SD = 3.17) groups and between Cnt and SelfS (M = 10.24, SD = 2.95) groups. There were no statistically significant differences between Dgn and SelfS groups, yet there were differences between Dgn and Phn groups except for AS subscale and some differences between SelfS and Phn groups. AQ total score between SelfS (M = 64.93, SD = 9.67) and Phn (M = 59.76, SD = 11.42), and SS subscale between SelfS (M = 18.54, SD = 3.43) and Phn (M = 16.67, SD = 4.45). Implying that SelfS and Dgn groups share more similarities, in comparison with Phn group. It is worth noting that differences in SS scores indicate that Self-suspected group might experience more difficulties in social situations, possibly exacerbating anxiety.

**CAT-Q-25** Total (F(3,528) = 66.46, $p < .0001$, $\eta^2 = .282$), Asm subscale (F(3,528) = 77.51, $p < .0001$, $\eta^2 = .307$), Cmp subscale (F(3,528) = 59.57, $p < .0001$, $\eta^2 = .254$) and Msk subscale (F(3,528) = 19.13, $p < .0001$, $\eta^2 = .099$) scores differed between groups (Table 6).Cnt had statistically significantly lower scores and differed from all other groups on all the scales. Msk was the only subscale that had no differences between autism groups. Dgn group differed from Phn on Total, Asm and Cmp scale scores, and from SelfS only on Cmp subscale. SelfS and Phn differed only on Asm subscale (Table 6). Group differences were also checked for anxiety

**Table 6.** *Descriptive statistics and differences between autism groups and controls in AQ-24 and CAT-Q-25 scores.*

| Variable | Diagnosis ($n$ = 42) M (SD) | Self-suspected ($n$ = 111) M (SD) | Phenotype ($n$ = 101) M (SD) | Controls ($n$ = 274) M (SD) | ANOVA F(3, 528) | $p$ | $\eta^2$ |
|---|---|---|---|---|---|---|---|
| **AQ-24** | | | | | | | |
| AQ total | 67.96 (9.93)[b,d,**] | 64.93 (9.67)[b,d,**] | 59.76 (11.42)[a,c,d,**] | 50.71 (8.74)[a,b,c,**] | 86.49 | < .0001 | .331 |
| Attention | 12.60 (2.19) [d,**] | 12.40 (2.73)[d,**] | 11.68 (2.85) [d,**] | 9.79 (2.82)[a,b,c,**] | 32.89 | < .0001 | .158 |
| Imagination | 9.98 (2.60)[d,**,b,*] | 9.00 (2.74)[d,*,e] | 8.69 (2.74)[a,*] | 8.28 (2.49)[a,**,c,*,e] | 7.18 | < .0001 | .039 |
| Details | 10.27 (3.17)[d,**,b,*] | 10.24 (2.95)[d,**,b,*e] | 8.79 (2.89)[a,c,*e] | 8.39 (2.97)[a,c,**] | 12.95 | < .0001 | .069 |
| Communication | 16.42 (3.93) [b,d,**] | 14.74 (4.03)[d,**] | 13.93 (3.93)[a,d,**] | 10.76 (2.85)[a,b,c,**] | 67.92 | < .0001 | .280 |
| Social Skills | 18.69 (3.22)[b,d,*] | 18.54 (3.43)[d,**b,*] | 16.67 (4.45)[d,**,a,c,*] | 13.48 (4.11)[b,c,**,a,*] | 58.27 | < .0001 | .250 |
| **CAT-Q-25** | | | | | | | |
| CAT-Q total | 116.86 (4.02)[d,**,b,*] | 109.01 (2.47)[d,**] | 101.55 (2.59)[d,**,a,*] | 75.74 (1.57)[a,b,c,**] | 66.46 | < .0001 | .282 |
| Assimilation | 49.02 (1.84)[d,**,b,*] | 48.05 (1.13)[d,**;b,*] | 42.50 (1.19)[d,**,a,c,*] | 30.65 (.72)[a,b,c,**] | 77.51 | < .0001 | .307 |
| Compensation | 35.71 (1.48)[d,**,b,c,*] | 30.32 (.91)[d,**,a,*] | 30.49 (.96)[d,**,a,*] | 20.45 (.58)[a,b,c,**] | 59.57 | < .0001 | .254 |
| Masking | 32.12 (1.34)[d,**] | 30.64 (.82)[d,**] | 28.56 (.86)[d,**] | 24.64 (.52)[a,b,c,**] | 19.13 | < .0001 | .099 |

*Note:* $p$-values depicted are Sidak's adjusted $p$-values for multiple comparisons. Abbreviations: $\eta^2$, partial eta squared; AQ-24, Autism Spectrum Quotient-24; Attention, Attention Switching subscale; Details, Attention to Details subscale; CAT-Q-25, Camouflaging Autistic Traits Questionnaire-25; Assimilation, Assimilation subscale; Compensation, Compensation subscale; Masking, Masking subscale. [a]Statistically significant differences from Diagnosis group. [b]Statistically significant differences from Phenotype group. [c]Statistically significant differences from Self-suspected group. [d]Statistically significant differences from Control group. [e]Non-significant when controlled with Kruskal-Wallis test. *$p$ < .05. **$p$ < .001.

measures as well as other measures used for discriminant validity and all scores were statistically significantly higher between three autistic groups and Cnt (SM, Table B), it is also worth noting that Phn differed in some scores i.e., SPAI Total from Dgn, but SelfS did not.

**Table 7.** *Descriptive statistics and main effects of sex in AQ-24 and CAT-Q-25 scores.*

| | **Females ($n$ = 434)** | **Males ($n$ = 94)** | **ANOVA** | | |
|---|---|---|---|---|---|
| **Variable** | **M (SD)** | **M (SD)** | **F(1, 526)** | $p$ | $\eta^2$ |
| **AQ-24** | | | | | |
| AQ total | 55.98 (11.64) | 60.55 (12.16) | 11.73 | **.001** | .022 |
| Attention | 10.91 (3.02) | 11.15 (2.9) | .50 | .480 | .001 |
| Imagination | 8.46 (2.64) | 9.09 (2.75) | 4.31 | .038[n.s.] | .008 |
| Details | 8.85 (3.04) | 9.72 (3.26) | 6.27 | **.013** | .012 |
| Com | 12.32 (3.89) | 14.31 (4.12) | 19.77 | **< .0001** | .036 |
| Social Skills | 15.45 (4.58) | 16.29 (4.42) | 2.59 | .108 | .005 |
| **CAT-Q-25** | | | | | |
| CAT-Q total | 90.79 (31.32) | 91.63 (27.31) | .06 | .811 | .000 |
| Assimilation | 37.82 (14.41) | 39.04 (13.86) | .57 | .451 | .001 |
| Compensation | 25.54 (11.20) | 26.19 (10.53) | .26 | .608 | .001 |
| Masking | 27.43 (9.31) | 26.39 (8.05) | 1.01 | .316 | .002 |

Abbreviations: $\eta^2$, partial eta squared; AQ-24, Autism Spectrum Quotient-24; Attention, Attention Switching subscale; Details, Attention to Details subscale; Com, Communication subscale; CAT-Q-25, Camouflaging Autistic Traits Questionnaire-25. [n.s.]Non-significant when controlled with Independent-Samples Mann-Whitney U test.

**Main effect of sex with females scoring higher compared with males** was in the AQ-24 Total score (F(1,526) = 11.73, $p$ = .001, $\eta^2$ = .022), Com (F(1,526) = 19.77, $p$ < .0001, $\eta^2$ = .036), AtD subscale (F(1,526) = 6.27, $p$ = .013, $\eta^2$ = .012) and Img score (F(1,526) = 4.31, $p$ = .038, $\eta^2$ = .008) (Table 7). However, Mann-Whitney U test showed n.s. results on the Img score (z = 31634.50, $p$ = .102, $\eta^2$ = .014). There was no main effect of sex on CAT-Q-25 total or subscale scores.

**Group × sex interactions**

With four groups and ten dependent variables there was no group × sex interaction effect (Pillai's Trace = .044, F(24,1707) = 1.05, $p$ = .392, $\eta^2$ = .015), but that might be due to significant correlations between dependent variables and unequal group sizes. When analysis with AQ-24 and CAT-Q-25 were conducted, interaction effects were present. As the assumption of homogeneity was

violated, I transformed AQ-24 and CAT-Q-25 scales for normality, comparison with untransformed result did not reveal any differences, so untransformed results with Pillai's Trace were used (Tabachnik & Fidell, 2014). No significant group × sex interaction was revealed with AQ-24 (Pillai's Trace = .023, F(15,1896) = .981, $p$ = .437, $\eta^2$ = .008), pairwise comparison within single sex can be found in Supplementary material (SM, Table A).

In **AQ-24** SS subscale *post hoc* Hochberg's GT2 revealed that in **females** there were statistically significant differences between all the groups: Dgn (M = 19.92, SD = 2.35) and SelfS (M = 17.51, SD = 4.14), Dgn (M = 19.92, SD = 2.35) and Cnt (M=13.45, SD = 4.59), SelfS (M = 17.51, SD = 4.14) and Cnt (M=13.45, SD = 4.59). In **males** there were no statistically significant differences between Dgn (M = 16.88, SD = 3.95) and SelfS (M = 18.25, SD = 3.37), however significant differences were found between Cnt (M = 13.68, SD = 4,40) and SelfS (M = 18.25, SD = 3.37) as well as between Cnt (M = 13.68, SD = 4,40) and Dgn (M =16.88, SD = 3.95) groups. When controlled with independent samples Kruskal-Wallis H, pairwise-comparisons held in female group but in males only the difference between SelfS and Cnt group remained statistically significant ($p$ < .0001).

**CAT-Q-25** showed a significant group × sex interaction effect (Pillai's Trace = .037, F(9,1471) = 2.06, $p$ = .030, $\eta^2$ = .012) in Total (F(3,490) = 5.00, $p$ = .002, $\eta^2$ = .030), Asm (F(3,490) = 4.72, $p$ = .003, $\eta^2$ = .028), Cmp (F(3,490) = 3.38, $p$ = .018, $\eta^2$ = .020), and Msk (F(3,490) = 3.31, $p$ = .020, $\eta^2$ = .020) scores, pairwise comparisons within single sex can be found in SM (Table A).

**Group × sex interactions when controlling for anxiety**

With all the dependent variables together, two-way MANCOVA revealed no statistically significant effect when anxiety (Pillai's Trace = .032, F(24,1665) = .74, $p$ = .810, $\eta^2$ = .011) or social anxiety (Pillai's Trace = .069, F(24,1473) = 1.45, $p$ = .075, $\eta^2$ = .023) were held constant, so again, dependent variables were analyzed test wise.

There was only a significant group × sex interaction effect with **CAT-Q-25** total and subscale scores when SPAI differential score was held constant (Pillai's Trace = .053, F(6,980) = 4.47, $p$ < .0001, $\eta^2$ = .027). CAT-Q-25 total score group × sex interaction (F(3,496) = 6.87, $p$ < .0001, $\eta^2$ =.040), Asm (F(3,469) = 7.90, < .0001, $\eta^2$ = .046), Cmp (F(3,496) = 3.63, $p$ = .013, $\eta^2$ = .022) and Msk (F(3,496) = 4.04, $p$ = .007, $\eta^2$ = .024) interactions (SM, Table C). But no interaction effect when general anxiety score was held constant (Pillai's Trace = .020, F(6,980) = 1.64, $p$ = .132, $\eta^2$= .010). With social anxiety held constant, Dgn group adjusted scores differed from Cnt on the total and all the subscale scores, SelfS differed from Cnt in all the adjusted scores, apart from Msk (SM, Table

C). With males, only Asm and Cmp adjusted scores showed any differences, Asm between SelfS (M = 44.53, SE = 1.76) and Cnt (M = 35.88, SE = 1.58) and in Cmp between Dgn (M = 30.54, SE = 2.32) and Cnt (M = 23.12, SE = 1.53). That might be as the sample size was small. Yet with females between-group comparisons showed statistically significant result on all the adjusted means of all the CAT-Q-25 scores. Cnt differed from other three, Dgn differed from Phen on all the scores and from SelfS on total and Cmp scores, but not Asm and Msk (see SM, Table C). No significant group × sex interaction effects were with **AQ-24** total and subscale sores when general anxiety (Pillai's Trace = .009, F(10,976) = .44, $p$ = .925, $\eta^2$ = .005) nor social anxiety (Pillai's Trace = .026, F(10,976) = 1.28, $p$ = .238, $\eta^2$ = .013) scores were held constant.

## Discussion

Main aim of the current paper was to adapt into Estonian Autism Spectrum Quotient (AQ) and Camouflaging Autistic Traits Questionnaire (CAT-Q) to fill a gap in the area and to screen for autism in Estonian adult population. Estonian version of Autism Spectrum Quotient (AQ-24) was found to reproduce the five-factor structure of the original scale (Baron-Cohen et al., 2001). As previous authors had found factor solutions from two to five (Hoekstra et al., 2011, Kloosterman et al., 2011, Zhang et al., 2016) both four and five factor structures were eventually more thoroughly considered, as the Attention Switching (AS) factor merged with Social Skills (SS) factor in the four-factor solution, thus losing information the 5-factor solution was kept. Item 46 (*New situations make me anxious*) had a .31 cross-loading to the SS factor – possibly explaining why the items loaded onto conceptually different factor. Content-wise quite similar factors have been found compared to original, with three-factor solution comprising of SS, Communication/mindreading (Com), and Attention to Detail/Patterns (AtD) (Austin, 2005), four-factor solution retained Imagination (Img) with the AS factor items removed except for item 46 that loaded onto the Sociability (SS) factor (Stewart & Austin, 2009).

Five-factor solution explained 44.2% of the overall variance, suggesting acceptable amount of explained variance (Peterson, 2000). Similar amount of variance 44.8% was explained by Kloosterman et al. (2011) 28-item 5-factor solution. SS internal consistency (α = .81) is comparable to other shorter scales alphas i.e., .86 (Kloosterman et al., 2011), .79-.86 (AQ-Short, Hoekstra et al., 2011). 50-item scale had lower internal consistencies (Baron-Cohen et al., 2001; Broadbent et al., 2013) as expected. Com and AtD had good internal consistencies (α = .74-.79) and Img and AS factors had fair alphas (.66-.69). Alphas were higher than in the original work (.63-.67, Baron-Cohen et al., 2001), and in other papers .59-.63 (Hurst et al., 2007), .40-.65 (Broadbent et al., 2013), but

these results come from snowball or student/general sample and using dichotomous scoring. Current sample included a high proportion of people with self-suspected autism, possibly increasing internal consistency as seen in Broadbent et al. (2013) paper, which calculated alphas in different samples incl. autistic participants. Factor correlations are also comparable, with AtD and Img without significant correlation, except for a weak (.26) significant correlation between Img and SS factor in AQ-24 that Stewart and Austin (2009) did not have. Negligible correlations between Img, AtD and AS are fairly common (Kloosterman et al., 2011; Stewart & Austin, 2009). Interestingly AQ-24 SS factor has negligible to weak correlations with all the aforementioned subscales, and strong correlation with AS, so it might be useful to check item wording for implicit social component.

Camouflaging Autistic Traits-Questionnaire Estonian version (CAT-Q-25) was found to have a three-factor structure. As CAT-Q three-factor original model (Hull et al., 2019) goodness of fit indices in the current sample were below acceptable fit (Hu & Bentler, 1999), it was decided to use the whole item pool in the analysis. An item (item 1) loaded onto Masking (Msk) instead of Compensation (Cmp), but that may be as actively compensating or hiding difficulties are somewhat similar and (*I deliberately copy*) in the current sample might thus be understood as hiding instead of compensation. It is difficult to compare CAT-Q and CAT-Q-25 as new statements were added offered by the autistic community to see how well the items work and how much variability may be in the compensation behaviors. It turned out that five newly created items substituted some of the original ones with 10, 8 and 7 items in factors, instead of 9, 8 and 8.

From the note that it is difficult to compare questionnaires with 20% different items, the total (.94 CAT-Q; .95 CAT-Q-25) and subscale alphas (.86-.93 CAT-Q; .87-.93 CAT-Q-25) are similar. Cassidy et al. (2020) using college student sample with mean age of 19.5 found lower Spearman rho's (.40-.83), yet the subscale correlations range from .40-.53 implying that they measure correlated, but different aspects of one scale – rising a question: are we too? It is important to underline, that CAT-Q-25 multicollinearity problems might make the scale unstable and difficult to interpret. Thus, it might prove useful to conduct IRT analyses to determine, what items can be removed without loss of information and discriminative power to make the scale as short and informative as possible.

On another note, it might be worth considering using a wider set of questions, that CAT-Q itself was based upon, to see whether there might be culturally sensitive items, as Cmp somewhat relies on mimicking socially appropriate behaviors and Msk use adjustment and monitoring of relaxation and interest on others, but what constitutes as socially appropriate might be seen and/or

interpreted differently by autists living in different cultural settings. Also, some items on the scale i.e., in Cmp factor (*I have researched the rules of social interactions (for example, by studying psychology or reading books on human behaviour) to improve my own social skills*) might be more focused on acquiring social skills in general, and not be as camouflaging-specific – so the depth of the behavior might come into play. And although CAT-Q is relatively new, there is one alternative (Livingston et al., 2020) based on somewhat different approach. For instance, Livingston et al. (2020) differentiate Shallow and Deep Compensation, alongside with Masking and Accommodation, so it might be useful to use existing questionnaires, add more recommendations from autistics themselves, maybe even some that include impression-management or social desirability aspects to differentiate neurotypical impression-management from camouflaging (Fombonne, 2020).

Third hypothesis focused on convergent and discriminant validity of the scales. In general, convergent validity between other similar scales is generally higher, with understandably lower correlations with AQ-24 subscales Img and AtD, that are connected to lesser extent to subscales that capture comprehension, skills, and ways of coping with interpersonal and social situations. AQ-24 AS subscale probably assesses at least to some extent (social) anxiety, as it has moderate correlations with AQ SS and CAT-Q Total score and Assimilation (Asm) subscale as well as convergent validity wise EST-Q2 anxiety subscale (.48), OCI-R (.45), and SPAI total (.57) and differential scores (.48) (being logical as it comprises of items like "*new situations make me anxious*" and "*I like to plan any activities I participate in carefully*") A possible solution might be to see if other scales, like RAADS-R (Ritvo et al., 2011) or Empathy Questionnaire (included in AAA, Baron-Cohen et al., 2005) might capture AS aspect of autistic behavior somewhat differently, as difficulties with switching from one activity to another may be a source of distress that goes beyond the meaning of an item like "*new situations make me anxious*".

Discriminant validity is lower, subscales like AQ-24 Img, AtD and AS and CAT-Q-25 Msk remain mostly in the range of .04-.40 except correlations with (social) anxiety and OCD measures. Higher insistence on routines might probably explain that .45 correlation between AS and OCI-R. Other high correlations are due to overlap between anxiety and (possible) lack of social skills, provoking anxiety. With CAT-Q-25 multicollinearity issue possibly a confounding factor, although higher correlation is reasonable too, as camouflaging behaviors take place in social settings. As ADHD is often co-morbid with autism it was assumed to have somewhat higher correlations between autism measures, yet they stayed mostly within the acceptable range of correlated enough to be related yet not so much to be identical or too similar. CAT-Q-25 had quite high correlations with

ADHD total score (.52) so did the Asm subscale (.53), which might be explained as ADHD, especially the hyperactive-impulsive aspect is more visible and under societal pressure to behave more normatively, so camouflaging, especially assimilation might be one strategy people use. As anxiety and social anxiety are quite common in autism and it has been documented that high anxiety might inflate the scores on self-report autism questionnaires.

It was also hypothesized that AQ-24 and CAT-Q-25 total and subscale scores will differ significantly between non-autistic, self-diagnosed autistic, close relative with autism and diagnosed autistic people. It was interesting, that self-suspected group was more similar with Diagnosis group than Phenotype group, with the exceptions of AS and Msk subscales. The most interesting finding was that, when controlled for general anxiety (EST-Q2 anxiety subscale) no statistically significant results remained and CAT-Q-25 adjusted scores remained statistically significant when controlled for social anxiety (with SPAI differential score). Within male participants only Asm and Cmp subscales showed some statistically significant results between autism groups and Controls. It is somewhat expectant, as literature has previously brought out that general anxiety and social anxiety can inflate AQ and CAT-Q scores (Ashwood et al., 2016; Hull et al., 2017; Hull et al., 2021; Jorgenson et al., 2020), yet it was presumed that a more significant effect will remain questionnaire-wise on AQ scales. But as anxiety disorders are more prevalent in females it might be so in autistic samples as well, and in addition male sample was quite small which might have affected the results.

With female sample it is interesting that when controlled for social anxiety there are group wise less differences between self-suspected and diagnosed females in comparison without controlling for social anxiety where self-suspected and autistic close relative groups had only statistically significant difference in Asm scores. It is especially interesting as there are people in the autistic close relatives group, that also suspect they have autism, and might possibly suggest that there might be more distinct differences between broader autism phenotype and self-suspected autism, either one is diagnostically more closely related to autism diagnosis thus solidifying the need for adequate screening and diagnostic measures. Or, as co-occurring difficulties were not checked explicitly in the current thesis, then what if there are other diagnostic issues behind the self-suspected autism scores, and that is why the scores differ? Especially considering, that CAT-Q, although created to measure autistic camouflaging, does not measure explicitly autism – so maybe other difficulties also bring about more pronounced CAT-Q scores even when social anxiety is controlled.

Sex differences were expected, and they mostly replicated previous results. It was interesting that CAT-Q-25 had no main effect of sex, although scale authors have demonstrated higher Msk and

Asm scores in females (Hull et al., 2020). Cage and Troxell-Whitman (2019) also noted a sex difference between CAT-Q total score ($p$ = .013). Yet Hull et al. (2021) has also found that sex itself had no interaction with camouflaging, so the differences might be also sample specific. AQ-24 had no sex differences on Asm, Img and SS subscales. The latter is interesting as Extreme Male Brain Theory posits that males exhibit more difficulties with social skills and autism can be described in terms of extreme male behaviors. Yet as the male-female scores remain between diagnosed and control groups, with males closer to the diagnosed group and as females exhibited higher scores for diagnosis – it may be describing differences between study samples, as self-diagnosed participants are usually excluded from studies. Another reason might be, that females experience, but not exhibit, more difficulties in situations requiring SS, which is one of the reasons behind growing interest in camouflaging behaviors. As anxiety had strong correlations with all the scales is also worth considering whether the items currently encapsule too much anxiety, instead of autism and whether this is specific to the current adaptation or is more widespread.

Youngsters, especially young females have reported that ca 61% of the worst traumatic situations they have experienced have been social like bullying, verbal insults, humiliations, social exclusion (Haruvi-Lamdan et al., 2018, 2020), so it is understandable that social situations can give rise to uncertainty and anxiety, autistic traits even predicting social phobia (Albantakis, 2020). Especially as social difficulties are written in the diagnostic criteria and as ruminative thoughts, characteristic of depression, might arise from autism related difficult or traumatic social situations (Dell'Osso et al., 2015). Also, autistic youngsters rely more on maladaptive ER strategies as demonstrated by Samson et al. (2014), that can lead to more depression and anxiety (Conner et al., 2020). As the studies have been cross-sectional by nature, then although we know, that camouflaging is associated with higher anxiety and depression (Bargiela et al., 2016) we cannot determine causality so maybe anxiety and depression force autistic people to camouflage? If they do – then it is imperative that we find out what environmental or individual aspects influence the development of anxiety and depression in autistic people and what can be done to support better wellbeing.

Most of the shortcomings of the study have been already brought out explicitly, but some of the methodological aspects that also need considering are that the study lacks officially confirmed autism and other possibly co-occurring diagnoses, IQ was not formally assessed, although self-reported education and length of the study somewhat helped to cross-validate the requirement and also the sex differences in the study are not biased towards males, but rather females – that can be seen both as a weakness and a strength of the study.

In conclusion, AQ-24 must be further assessed, concerning item content and to use a more representative sample of participants with autism diagnosis to check whether the items work similarly between autistic and non-autistic participants. Also using item response theory, it is maybe possible to shorten the questionnaire even more without losing information. Including a personality inventory to see whether some autistic traits currently measured might also be associated with adaptive or non-adaptive personality traits might have clinically significant impact. CAT-Q-25 is a promising questionnaire, but as the items are too closely related it might also be useful to turn to item response theory and see what items can be removed without losing discriminatory power and as the camouflaging is a relatively new topic it also might be useful to consult with Estonian autistic community and other autism experts to capture possibly culture specific camouflaging behaviors. As an important finding – when controlling for social or general anxiety no sex and group interaction on AQ-24 scores was revealed, yet sex and group interaction effect for CAT-Q-25 scores remained when controlling for social, not general, anxiety. If autism and anxiety are so closely related than it would be worth considering in the future also the mechanisms by which the anxiety might influence or exacerbate autistic behaviors. So, with growing awareness the quality of life of autistic people, both males and females, might be improved.

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## Supplementary Material

**Table A.** *Descriptive statistics and differences between autism groups and controls in AQ and CAT-Q scores in females and males.*

| | Diagnosis M (SD) | Self-suspected M (SD) | Phenotype M (SD) | Controls M (SD) | ANOVA | | |
|---|---|---|---|---|---|---|---|
| **Females** | **($n$ = 26)** | **($n$ = 78)** | **($n$ = 94)** | **($n$ = 236)** | **F(3,434)** | ***p*** | **$\eta^2$** |
| **AQ-24** | | | | | | | |
| Total | 69.73 (9.35)[b,d,**,c,*,e] | 63.97 (9.21)[d,**,a,*e] | 59.85 (11.69)[a,d,**] | 50.28 (8.82)[a,b,c,**] | 66.43 | < .0001 | .323 |
| Routines | 13.04 (2.07)[d,**] | 12.47 (2.67)[d,**] | 11.71 (2.93)[d,**] | 9.83 (2.81) [a,b,c,**] | 27.80 | < .0001 | .162 |
| Imagination | 10.00 (2.90)[d,*] | 8,82 (2.81)[b,*,e] | 8.54 (2.66)[c,*,e] | 8.13 (2.48)[a,*] | 4.79 | .003 | .032 |
| Numeric | 10.31 (3.33)[d,*] | 10.06 (2.91)[d,**,g*] | 8.81 (2.93)[h,*] | 8.30 (2.93)[c,**,a,*] | 9.25 | < .0001 | .061 |
| Com | 16.46 (4.00)[d,**,b,c,*,e] | 14.32 (3.91)[d,**,a,*,e] | 13.88 (4.08)[d,**,a,*] | 10.58 (2.72)[a,b,c,**] | 50.31 | < .0001 | .260 |
| Social Skills | 19.92 (2.35)[d,**,b,*] | 18.29 (3.65)[d,**] | 16.90 (4.40)[d,**,a,*] | 10.58 (2.72)[a,b,c,**] | 48.47 | < .0001 | .253 |
| **CAT-Q-25** | | | | | | | |
| Total | 127.73 (26.32)[b,d,**,c,*] | 110.46 (26.60)[d,**,a*] | 103.04 (29.86)[a,d,**] | 75.34 (23.09)[a,b,c,**] | 67.61 | < .0001 | .321 |
| Asm | 54.15 (10.19)[b,d,**] | 47.96 (12.22)[d,**,b,*,e] | 43.12 (13.73)[a,d,**,c*,e] | 30.55 (10.95)[a,b,c,**] | 72.06 | < .0001 | .335 |
| Cmp | 38.46 (10.42)[d,**;b,c,*,e] | 30.91 (10.79)[d**,a,*,e] | 30.85 (11.04)[d**,a,*,e] | 20.23 (8.11)[a,b,c,**] | 50.20 | < .0001 | .292 |
| Msk | 35.12 (9.88)[d,**,b,*,e] | 31.59 (9.64)[d,**] | 29.07 (8.67)[d,**,a,*,e] | 24.56 (8.14)[a,b,c,**] | 22.45 | < .0001 | .135 |
| **Males** | **($n$ = 16)** | **($n$ = 33)** | **($n$ = 7)** | **($n$ = 38)** | **F(3,94)** | ***p*** | **$\eta^2$** |
| **AQ-24** | | | | | | | |
| Total | 65.13 (11.56)[d,**] | 68.12 (10.53)[d,**] | 58.14 (9.12) | 52.50 (8.86)[a,c,**] | 15.75 | < .0001 | .344 |
| Routines | 11.75 (2.49)[i,*] | 12.36 (2.80)[d,*] | 11.29 (3.35) | 9.82 (2.59)[c,f,*] | 5.55 | .002 | .156 |
| Imagination | 9.81 (2.23) | 9.67 (2.87) | 8.14 (3.63) | 8.45 (2.59) | 1.87 | .141 | .059 |
| Numeric | 10.19 (3.33) | 10.67 (2.84)[i,*] | 8.86 (3.24) | 8.87 (3.43)[h,*] | 2.15 | .100 | .067 |
| Com | 16.50 (4.24)[d,**] | 16.36 (3.79)[d,**] | 14.14 (2.48) | 11.63 (2.97)[a,c,**] | 13.41 | < .0001 | .309 |
| Social Skills | 16.88 (3.95)[d,*,e] | 19.06 (2.83)[d,**] | 15.71 (4.39) | 13.74 (4.36)[c,**,a,*,e] | 11.67 | < .0001 | .280 |
| **CAT-Q-25** | | | | | | | |
| Total | 99.19 (32.85)[d,*] | 105.58 (23.32)[d,**] | 81.43 (30.18) | 78.21 (20.40)[c,**,a,*] | 8.21 | < .0001 | .215 |
| Asm | 40.69 (15.85)[d,*,e] | 48.24 (10.49)[d,**,b,*] | 34.14 (7.86)[c,*] | 31.26 (11.51)[c,**,a,*,e] | 12.67 | < .0001 | .297 |
| Cmp | 31.25 (10.50)[d,*] | 28.94 (10.58)[d,*] | 25.57 (15.90) | 21.79 (7.64)[a,c,*] | 4.71 | .004 | .136 |
| Msk | 27.25 (9.53) | 28.39 (7.29) | 27.71 (12.11) | 25.16 (6.83) | 1.88 | .139 | .059 |

*Note:* *p*-values depicted are Sidak's adjusted *p*-values for multiple comparisons. Abbreviations: $\eta^2$, partial eta squared; AQ-24, Autism Spectrum Quotient-24; Com, Communication subscale; CAT-Q-25, Camouflaging Autistic Traits Questionnaire-25; Asm, Assimilation subscale; Cmp, Compensation subscale; Msk,

Masking subscale. [a]Statistically significant differences from Diagnosis group. [b]Statistically significant differences from Phenotype group. [c]Statistically significant differences from Self-suspected group. [d]Statistically significant differences from Control group. [e]Non-significant when controlled with Kruskal-Wallis test. [f]Statistically significant differences from Diagnosis group, when controlled with Kruskal-Wallis test. [g]Statistically significant differences from Phenotype group, when controlled with Kruskal-Wallis test. [h]Statistically significant differences from Self-suspected group, when controlled with Kruskal-Wallis test. [i]Statistically significant differences from Control group, when controlled with Kruskal-Wallis test. *$p < .05$. **$p < .001$.

**Table B.** *Descriptive statistics and differences between autism groups and controls in SPAI, EST-Q2, ADHD, and OCI-R scores.*

| | **Diagnosis (*n* = 42)** | **Self-suspected (*n* = 105)** | **Phenotype (*n* = 95)** | **Controls (*n* = 256)** | **ANOVA** | | |
|---|---|---|---|---|---|---|---|
| **Variable** | **M (SD)** | **M (SD)** | **M (SD)** | **M (SD)** | **F(3,494)** | ***p*** | **$\eta^2$** |
| **SPAI** | | | | | | | |
| Total | 84.51 (28.39)[d,**,b,c,*,e] | 70.33 (25.51)[d,**,a,*,e] | 65.86 (32.25)[d,**,a,*] | 47.50 (24.09)[a,b,c,**] | 37.62 | < .0001 | .186 |
| Dif | 47.13 (13.13)[d,**] | 46.35 (15.19)[d,**] | 41.72 (18.56)[d,*] | 35.24 (17.52)[a,c,**,b,*] | 14.45 | < .0001 | .081 |
| **EST-Q2** | | | | | | | |
| DEP | 17.36 (7.80)[d,**] | 16.53 (6.52)[d,**] | 14.35 (7.46)[d,**] | 10.00 (6.42)[a,b,c,**] | 33.01 | < .0001 | .167 |
| Anxiety | 12.48 (5.75)[d,**] | 12.61 (4.85)[d,**] | 11.99 (5.72)[d,**] | 8.55 (4.74)[a,b,c,**] | 23.71 | < .0001 | .126 |
| Fatigue | 10.26 (4.41)[d,**] | 10.34 (3.79)[d,**] | 10.20 (3.97)[d,**] | 7.60 (4.05)[a,b,c,**] | 18.45 | < .0001 | .101 |
| **ADHD** | | | | | | | |
| Total | 13.71 (5.41)[d,**,b,*] | 12.21 (4.54)[d,**] | 11.34 (4.87)[d,**,a,*] | 8.84 (4.31)[a,b,c,**] | 24.17 | < .0001 | .128 |
| H-I | 7.26 (2.79)[d,**,b,*,e] | 6.32 (2.52)[d,**] | 5.80 (2.72)[d,**,a,*,e] | 4.49 (2.34)[a,b,c,**] | 24.72 | < .0001 | .131 |
| IA | 6.45 (3.26)[d,**] | 5.89 (2.77)[d,**] | 5.54 (2.77)[d,*] | 4.34 (2.50)[a,c,**,b,*] | 14.21 | < .0001 | .079 |
| **OCI-R** | 23.50 (14.96)[d,**] | 19.63 (10.17)[d,**] | 18.71 (12.70)[d,**] | 11.00 (8.26)[a,b,c,**] | 33.32 | < .0001 | .168 |

*Note: p*-values depicted are Sidak's adjusted *p*-values for multiple comparisons. Abbreviations: $\eta^2$, partial eta squared; EST-Q2, Emotional State Questionnaire-2; DEP, Depression subscale; ADHD, ASRS-V1.1 Screener; H-I, Hyperactivity-Impulsivity subscale; IA, inattentive subscale; SPAI, Social Phobia and Anxiety Inventory; SPAI dif, social phobia differential score; OCI-R, Obsessive-Compulsive Inventory—Revised, total score. [a]Statistically significant differences from

Diagnosis group. [b]Statistically significant differences from Phenotype group. [c]Statistically significant differences from Self-suspected group. [d]Statistically significant differences from Control group. [e]Non-significant when controlled with Kruskal-Wallis test. *$p < .05$. **$p < .001$

**Table C.** *Descriptive statistics and differences between autism groups and controls in CAT-Q-25 scores in general and between sexes, when controlling for social anxiety.*

| Variable | Diagnosis ($n$ = 42) $M_{adj}$ (SE) | Self-suspected ($n$ = 111) $M_{adj}$ (SE) | Phenotype ($n$ = 101) $M_{adj}$ (SE) | Controls ($n$ = 274) $M_{adj}$ (SE) | ANCOVA F | $p$ | $\eta^2$ |
|---|---|---|---|---|---|---|---|
| **Total sample** | | | | | **(3,500)** | | |
| CAT-Q total | 108.63 (3.66)$^{d,**}$ | 102.43 (2.50)$^{d,**}$ | 93.49 (4.83) | 81.79 (2.06)$^{a,c,**}$ | 45.80 | **< .0001** | .216 |
| Assimilation | 44.53 (1.53)$^{d,**}$ | 44.92 (1.05)$^{d,**}$ | 39.59 (2.02) | 33.90 (.86)$^{a,c,**}$ | 54.67 | **< .0001** | .247 |
| Compensation | 34.02 (1.48)$^{d,**,b,c,*}$ | 28.75 (1.01)$^{d,**,a,*}$ | 27.18 (1.95)$^{a,*}$ | 21.87 (.83)$^{a,c,**}$ | 43.59 | **< .0001** | .207 |
| Masking | 30.07 (1.30)$^{d,*}$ | 28.76 (.89) | 26.71 (1.72) | 26.03 (.73)$^{a,*}$ | 9.57 | **< .0001** | .054 |
| **Females** | | | | | **(3,410)** | | |
| CAT-Q total | 122.20 (4.51)$^{b,d,**,c,*}$ | 105.52 (2.65)$^{d,**,a,*}$ | 100.41 (2.39)$^{a,d,**}$ | 77.65 (1.55)$^{a,b,c,**}$ | 51.92 | **< .0001** | .275 |
| Assimilation | 50.85 (1.89)$^{b,d,**}$ | 45.31 (1.11)$^{d,**}$ | 41.57 (1.00)$^{a,d,**}$ | 31.96 (.65)$^{a,b,c,**}$ | 59.17 | **< .0001** | .302 |
| Compensation | 37.52 (1.82)$^{d,**,b,c,*}$ | 30.03 (1.07)$^{d,**,a,*}$ | 29.75 (.98)$^{d,**,a,*}$ | 20.65 (.63)$^{a,b,c,**}$ | 46.18 | **< .0001** | .253 |
| Masking | 33.84 (1.61)$^{d,**,b,*}$ | 30.30 (.94)$^{d,**}$ | 28.62 (.86)$^{a,d,*}$ | 25.12 (.55)$^{a,c,**,b,*}$ | 13.31 | **< .0001** | .089 |
| **Males** | | | | | **(1,85)** | | |
| CAT-Q total | 95.06 (5.73) | 99.33 (4.20) | 86.56 (9.37) | 86.94 (3.77) | 2.22 | = .098 | .073 |
| Assimilation | 38.22 (2.40) | 44.53 (1.76)$^{d,*}$ | 37.61 (3.92) | 35.88 (1.58)$^{c,*}$ | 3.87 | **= .012** | .120 |
| Compensation | 30.54 (2.32)$^{d,*}$ | 27.58 (1.70) | 24.14 (3.79) | 23.12 (1.53)$^{a,*}$ | 2.82 | **= .044** | .091 |
| Masking | 26.30 (2.04) | 27.22 (1.49) | 24.81 (3.33) | 26.94 (1.34) | .44 | = .729 | .015 |

*Note:* $p$-values depicted are Sidak's adjusted $p$-values for multiple comparisons. Abbreviations: $\eta^2$, partial eta squared; CAT-Q-25, Camouflaging Autistic Traits Questionnaire-25; Assimilation, Assimilation subscale; Compensation, Compensation subscale; Masking, Masking subscale. [a]Statistically significant differences from Diagnosis group. [b]Statistically significant differences from Phenotype group. [c]Statistically significant differences from Self-suspected group. [d]Statistically significant differences from Control group. *$p < .05$. **$p < .001$.

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