# COVID-19 Anxiety and Core Symptom Severity in Children with Autism Spectrum Disorder

Master Thesis

Suzanne de Vries

583164sv@eur.nl

Clinical Child and Adolescent Psychology

Erasmus University Rotterdam

Linda Dekker & Ruth van der Hallen

August 6, 2023

9106 words

## Abstract

During the COVID-19 pandemic, children with Autism Spectrum Disorder (ASD) were found to be even more vulnerable to mental health difficulties than their typically developing peers. This study investigates whether differences within the group of children with ASD can impact their response to the pandemic. Specifically, it examines the relationship between COVID-19 anxiety and the severity of ASD symptoms in a sample of 48 children, using the SRS-2 and a newly developed COVID-19 anxiety questionnaire. In addition, it explores the possible moderating effect of general parental anxiety using the anxiety subscale of the BSI. Using linear regressions and investigating per SRS-2 subscale, it was discovered that a significant positive relationship exists between COVID-19 anxiety and the SRS-2 subscales of social cognition and social motivation, and that parental anxiety is not a significant moderator in any of the analyses. The results imply that children that experience more anxiety about COVID-19 also experience more deficits in perceiving, interpreting, and evaluating social information, and less motivation to engage in social interactions to achieve acceptance or approval of others. Understanding the effects of anxiety on these children's daily life and functioning is of great importance to ensure adequate and fitting policies and support.

# COVID-19 Anxiety and Core Symptom Severity in Children with Autism Spectrum Disorder

On January 9, 2020, the Dutch Broadcasting Foundation (NOS) reported that a mysterious pneumonia-like illness in China was caused by an unknown virus (Nederlandse Omroep Stichting, 2020a). The disease, labeled COVID-19, could not be contained and was labeled a pandemic by the World Health Organisation (WHO) on March 11, 2020 (Cucinotta & Vanelli, 2020). The pandemic did not only have physical ramifications but, importantly, also psycho-emotional risks. For children with neurodevelopmental disorders, such as Autism Spectrum Disorder (ASD), the consequences of the pandemic might be exceptionally severe. Children with ASD are already vulnerable due to the high comorbidity with anxiety disorders, and their higher levels of day-to-day anxiety compared to their typically developing peers (Van Steensel et al., 2011; McVey, 2019). In addition, they experience more anxiety about COVID-19 than neurotypical peers (Pearcey et al., 2020; Corbett et al., 2021). This study aims to contribute to ongoing research efforts by investigating the influence of COVID-19-specific anxiety on the severity of ASD symptoms, as well as the possible influence of parental anxiety on this relationship. Examining the effects that COVID-19 has on this population is crucial to ensure proper support for children and their parents, as well as guidelines for schools, professionals, and policymakers.

ASD is characterized by two core symptoms: deficits in social communication and interaction across contexts; and restricted, repetitive patterns of behavior, interests, and activities (American Psychiatric Association, 2013). In addition, many individuals with ASD have an intellectual or language impairment. The prevalence is estimated at around 1%, with most cases typically recognized at age two (American Psychiatric Association, 2013).

Compared to typically developing children, those with ASD may be at an even higher risk of developing problems due to the COVID-19 pandemic, at the hand of their vulnerability to

sudden, unpredictable, and complex changes (Tarbox et al., 2020). Emotions like fear, worry, anger, and frustration may be more prevalent. Especially children with ASD can get stuck ruminating about when the situation will change again, that things are supposed to be different, or worry about challenging aspects of this new world (Tarbox et al., 2020). They may fear infections in their environment or being unable to see family or friends, and feel uncertain about when the pandemic and associated containment measures might end (Duan et al., 2020). Several aspects of ASD symptoms are significantly linked to anxiety, such as social skill deficits, sensory defensiveness, and communication deficits (Bitsika & Sharpley, 2017). In addition, around 40% of individuals with ASD are also diagnosed with at least one anxiety disorder (Van Steensel et al., 2011; McVey, 2019). Social fear, generalized worry, and phobias were even included in the earliest descriptions of ASD (Asperger, 1944), speaking for their significance in the disorder. Specifically because having comorbid symptoms or disorders is quite common, the mental health consequences in this group can be devastating (Altable, 2020).

Indeed, anxiety is generally associated with social difficulties, the first core symptom of ASD, even independently of the presence of ASD (Factor et al., 2017). In children with ASD, social difficulties can be worsened by comorbid anxiety problems (Factor et al., 2017; McVey et al., 2018). Youth with ASD and social anxiety were found to have more social functioning deficits, mostly related to initiating interactions and social awareness (Chang et al., 2012). Furthermore, Factor et al. (2017) found that social communication skills were poorer in anxious children with ASD than in non-anxious children, possibly because of behavioral inhibition and a lack of practical communication skills. Social motivation also lagged, which could be explained by the absence of social reward that individuals with ASD experience in social situations (Factor et al., 2017). Higher anxiety levels in ASD can also be

related to impairments in social reciprocity, but this relationship might depend on IQ (Sukhodolsky et al., 2008).

The second core symptom of ASD consists of two elements: sensory-motor repetitive behaviors (stereotypic behavior); and insistence on sameness, rituals, and repetitive thinking (Cashin & Yorke, 2018). Higher anxiety levels in children with ASD were associated with more stereotyped behaviors in the research by Sukhodolsky et al. (2008). Both neurotypical individuals and those with ASD have been shown to use ritualization and repetitive behavior as a coping response to anxiety (Lang et al., 2015; Sukhodolsky et al., 2008; Larkin et al., 2019; Cashin & Yorke, 2018). Insistence on sameness, including routines and narrow interests, was also related to anxiety. Insistence may function to narrow sensory input (Lidstone et al., 2014). During times of less external structure in routines, such as the COVID-19 pandemic, the intrusion of restricted and repetitive behavior can become more clear-cut and interfere with functioning. In addition, individuals with ASD and anxiety are more likely to become "locked into" such behavior (Cashin & Yorke, 2018). So-called "intolerance of uncertainty" may play an important role in the relationship between anxiety and restricted, repetitive behaviors in ASD (Wigham et al., 2015), and the level of uncertainty is definitely elevated during these times.

At the time of writing, research on the relationship between anxiety and the core ASD symptoms in the specific context of the COVID-19 pandemic is still scarce; however, more and more studies are investigating the effects on this vulnerable population. Concerning anxiety about the pandemic, children with ASD have been shown to experience more anxiety and stress about COVID-19 than typically developing children (Pearcey et al., 2020; Corbett et al., 2021). According to Duvekot et al. (2018), an increase in anxiety symptoms appears to be related to an increased risk of social communication difficulties. When their daily routines are disrupted, children with ASD can be distracted even more quickly and, therefore,

experience regression of their behaviors and increased anxiety or stress (Catalano et al., 2018). In an observational cross-sectional study, Amorim et al. (2020) found that 41.7% of parents of children with ASD reported behavioral changes related to anxiety in their children, and that quarantine had impacted the emotion management of children with ASD more than that of the control group (55.8% vs. 30.1%). Additionally, it has been found that children with ASD can experience autism-specific anxiety symptoms, including phobias, social fear, routine anxiety, and compulsive, ritualistic behavior. This underlines the close link between anxiety and the core ASD symptoms (Asbury & Toseeb, 2023).

Concerning their core symptom severity in times of the pandemic, a study in Canada showed that parent-reported autistic characteristics and social-emotional concerns were increased (Turner et al., 2023). The same was found by Asbury et al. (2021), who highlighted increased autism-related traits during the pandemic. Within two months of the onset of the pandemic, over half of the children with ASD developed new symptoms in a study by Vasa et al. (2021), and a little less than half experienced a worsening of their psychiatric disorder. Hosokawa et al. (2021) found that children with ASD were more frustrated than their typically developing peers, had a lower understanding of COVID-19, and displayed more restricted and repetitive behavior. O'Sullivan et al. (2021) found that repetitive and rigid behaviors were the most challenging conducts for children with ASD during the pandemic. Following these findings, participants with ASD displayed higher levels of repetitive, restrictive, and stereotyped behaviors during the pandemic than before (Martínez-González et al., 2021). Furthermore, many children have had to deal with the interruption of in-person therapy, another reason for extra difficulties with ASD symptoms (Eshraghi et al., 2022).

As parents or caregivers are usually the most influential figures in the lives of children, especially those with special needs, the levels of anxiety that parents of children with ASD experience might influence the relationship between COVID-19 anxiety and the core ASD

symptoms in the child. Generally, caregivers of children with ASD experience significantly more stress and anxiety than caregivers of typically developing children (Mutluer et al., 2020), which can also lead to alterations in parenting style or behavior. These alterations reinforce the ASD symptoms and can increase their severity (Rodriguez et al., 2019). Social support is one of the most vital protective factors for parents, and precisely this support decreases during the pandemic's mandatory isolation (Mutluer et al., 2020).

Emerging evidence shows a "spillover hypothesis," where parents' high levels of stress and anxiety lead to worsened autism symptoms, behavioral challenges, and mental health problems in their children with ASD, possibly via altered parenting strategies or imitation of unhealthy coping strategies. Children with ASD may also be prone to imitate their parents' stress in addition to experiencing their own pandemic-related anxiety (Eshraghi et al., 2022). It was found that for older youth, higher perceived stress of their caregiver was indeed associated with more autistic traits during the pandemic (Turner et al., 2023). During the first COVID-19 lockdown, the levels of anxiety and depression that mothers of children with ASD felt were significantly related to, among other factors, the challenging behavior of their child (Miniarikova et al., 2022). Elevated parental depression and anxiety symptoms was one of the factors that increased the vulnerability to psychological distress in children with ASD in a study by Vasa et al. (2021). Similarly, higher caregiver distress was associated with more anxiety and depression during the pandemic in typically developing youth (Rosen et al., 2020).

The present study intends to contribute to the ongoing research concerning the impact of the COVID-19 pandemic on children with ASD by investigating the relationship between COVID-19 anxiety and autism symptom severity, as well as the possible moderating influence of parental anxiety. The first aim of this study is to understand the relationship between child anxiety about the COVID-19 pandemic and the social functioning and

restricted, repetitive behavior, interests, and activities of children with ASD. In line with, among others, the findings of Duvekot et al. (2018) and Hosokawa et al. (2021) that more anxiety was associated with more severe social difficulties and more restrictive and repetitive behavior, it is hypothesized that COVID-19-anxiety will be positively related to both core symptoms. That is, children who are more anxious about COVID-19 will also generally experience more severe ASD symptomatology. Second, this study aims to uncover whether parental anxiety moderates this relationship. Given the results of the research by Miniarikova et al. (2022) and Turner et al. (2023), which showed that mothers' anxiety was related to child challenging behaviors and that higher caregiver stress was associated with more child ASD traits, it is hypothesized that the relationship between anxiety about the COVID-19 pandemic and both core symptoms will be moderated by general parental anxiety, where parental anxiety will strengthen this relationship.

Investigating the effects of COVID-19-related anxiety on the two core ASD symptoms is crucial. This group is already likely to experience comorbid mental health issues, including anxiety (Van Steensel et al., 2011). During the pandemic, they might experience even more social hurdles or anxiety, and an added, confusing, physical component to their anxiety.

## Methods

### Participants and Procedure

This research makes use of data collected during T1 of a larger and more extensive mixed-methods multi-center cohort study (Dekker et al., 2021), in which a total of 55 of the originally 202 approached parents completed measures related to overall functioning, family functioning, autism symptoms, and COVID-19 impact. T1 was collected in January 2021, during the second COVID-19 lockdown in the Netherlands. The children received care from one of three big mental health care institutions in and around Rotterdam, the Netherlands, in the year prior to COVID-19. The inclusion criteria were that the children were aged 4-21 and

that clinical data (the Child Behavior Checklist and/or Social Responsiveness Scale) was available between March 2019 and March 2020. Participants were excluded if they could not provide active consent (Dekker et al., 2021). The descriptive statistics of the participants can be found in Table 1.

Variables were measured using online parent-report questionnaires. For this study, data from the questionnaires for COVID-19 anxiety, ASD symptom severity, and parent general anxiety was used. Some of the 55 parents did not complete all of the questionnaires. Specifically, three participants did not complete any of the questionnaires used to answer the present hypotheses, and were therefore excluded from the current study. Four extra participants were removed, because they only completed one of the questionnaires. After these cases were removed, the dataset consisted of 48 participants (44 females) who completed all three measures used in the current study. The exact methods are elaborated on in the Materials section below.

Participants provided online consent before being sent the questionnaires via Qualtrics (Qualtrics, 2021). Completing all measures took about 45 minutes. Participants first shared some demographic data, after which they completed all questionnaires one by one. Participants could select their answer by clicking, or use the keyboard to enter information.

**Table 1**

*Descriptive Statistics of Sample*

| | Mean | Minimum | Maximum | Std. Deviation |
|---|---|---|---|---|
| Age Parents | 45.19 | 29.75 | 57.23 | 7.32 |
| Age Children | 12.82 | 5.86 | 22.06 | 4.67 |
| | Male | Female | | |
| Gender Parents | 4 (8.3%) | 44 (91.7%) | | |

| | | | |
|---|---|---|---|
| Gender Children | 34 (70.8%) | 14 (29.2%) | |
| | Bio. Father | Bio. Mother | Foster Parent |
| Role of Parents | 4 (8.3%) | 42 (87.5%) | 2 (4.2%) |
| | Both Parents | Father only | Mother only |
| Family Situation | 34 (70.8%) | 2 (15.4% of 29.2%) | 12 (84.6% of 29.2%) |

**Materials**

To measure the amount of parent-reported anxiety a child experiences about COVID-19, a COVID-19 anxiety questionnaire developed by a national collaboration (Generation R) was used (Appendix A). It consisted of thirteen questions with varying answering formats. This study uses eight of the thirteen questions of the original measure. Specifically, these items that are completed on a scale where a higher score means more anxiety. These were also the items most directly related to the amount of anxiety a child experienced. Seven items were on a scale of 1-5, and one on a scale of 1-10. The 10-point Likert scale ranges from 1 ("not worried") to 10 ("extremely worried"), while five questions use a 5-point Likert scale with options from 1 (e.g., "never") to 5 (e.g., "always or almost always"), and two questions use another 5-point Likert scale. Example items are: "How worried has your child been in the last 7 days about the COVID-19 crisis?", "Since the outbreak of the corona crisis, my child sees others in his/her environment, such as people nearby or in shops, as a threat to his/her well-being" and "My child worries because of the COVID-19 pandemic about…", with options including "Getting ill himself/herself," "That it will take a long time for daily life becoming normal again" and "That he/she cannot see his/her family or friends." Total scores were

computed by adding the scores of the eight questions together, which could be a minimum of 8 and a maximum of 45. To have standardized scores for all measures in the analyses, Z-scores were requested of the total scores, which were then transformed into T-scores using the formula T = (Z * 10) + 50. The item "How worried has your child been in the last 7 days about the corona crisis?" with a 10-point Likert scale from "Not worried" to "Extremely worried" was seen as the central question and most important as an indication of COVID-19 anxiety. Therefore, the 10-point scale was not transformed into a 5-point scale before standardization.

The parent-report Social Responsiveness Scale (SRS-2; Roeyers et al., 2011) was used to measure ASD core symptoms. The Dutch version consists of 65 items in five subscales: social awareness, social cognition, social communication, social motivation, and autistic preoccupations. The first four subscales measure the core symptom of social functioning, and the last subscale measures the core symptom of restricted, repetitive behavior, interests, and activities. Items were responded to using a 4-point Likert scale from 0 ("not true") to 3 ("almost always true"). It has good internal consistency (between .93 and .95) and validity (Roeyers et al., 2011). The SRS-2 uses norm tables to convert raw scores into T-scores, which indicate the severity of ASD symptoms. The mean is 50, with a standard deviation of 10. A total T-score smaller than 40 indicates mild autism symptomatology, between 40-60 indicates average autism symptomatology, between 61-75 indicates severe autism symptomatology, and a total T-score of 76 or higher indicates very severe autism symptomatology (Roeyers et al., 2011). For these analyses, totals for the SRS-2 subscale scores were computed. Then, using the norm tables 2 and 5 of children of the normal population, from Appendix A of the Dutch version of the SRS-2 manual, the raw scores were transformed into the corresponding T-scores (Roeyers et al., 2015). These T-scores were used for the analyses.

Lastly, parents completed the anxiety subscale of the Brief Symptom Inventory (BSI; Derogatis, 1993; De Beurs, 2008) to determine the general anxiety that parents experience. The anxiety subscale consists of six physical or emotional complaints, which are ranked on a 5-point Likert scale from 0 ("not at all") to 4 ("very much") about such complaints during the past week. Total scores could range from 0 to 24 and were standardized into T-scores for easy comparison, provided the raw scores were normally distributed. The internal consistency and test-retest reliability have been supported, and the anxiety subscale has a Cronbach's Alpha of .85 (De Beurs, n.d.).

## Statistical Analyses

All analyses were performed using version 28 of the statistical software program IBM SPSS Statistics. The significance of all hypotheses was tested using the standard alpha level of .05.

To get an idea of the severity of autism symptoms among the children of the participants, a descriptives table was created. The mean, minimum and maximum scores of the SRS-2 showed that, on average, parents reported very severe autistic preoccupation symptomatology, severe problems with social cognition, social communication, and social motivation, and average autism symptomatology related to social awareness. The data can be seen in Table 2. In addition, to get an idea of the level of COVID-19 anxiety that the children in this sample experienced, descriptives tables were created for the raw scores and T-scores. Given that the minimum possible raw score is eight and the maximum possible raw score is 45, it became clear that, on average, children in the sample experience an approximately mean level of anxiety. The data can be seen in Table 3.

**Table 2**

*Descriptive Statistics of the SRS-2 T-Scores per Subscale*

| | Mean | Minimum | Maximum |
|---|---|---|---|
| Social Awareness | 58.46 | 37 | 79 |
| Social Cognition | 74.54 | 59 | 97 |
| Social Communication | 70.69 | 55 | 102 |
| Social Motivation | 67.29 | 47 | 88 |
| Autistic Preoccupations | 79.52 | 47 | 133 |

*Note*. $N = 48$

**Table 3**

*Descriptive Statistics of the COVID-19 Anxiety*

| | Mean | Minimum | Maximum |
|---|---|---|---|
| COVID-19 Anxiety Raw Scores | 20.08 | 8 | 39 |
| COVID-19 Anxiety T-scores | 50 | 35.87 | 72.12 |

*Note*. $N = 48$

**Assumptions**

Before performing the necessary analyses, the assumptions were checked. Outliers were checked using standardized residuals, Mahalanobis Distance, Cook's Distance, and scatterplots. Because this is a smaller sample, the Mahalanobis distance should stay below 15 to have no outliers. Cook's Distance should stay below 1 to ensure no case influences the analyses (Field, 2013). Normality and linearity were checked using a scatterplot of the standardized predicted values and standardized residuals, together with a Q-Q plot. The homogeneity of variance was checked by plotting the unstandardized predicted values against the standardized residuals in a scatterplot.

In the regressions of COVID-19 anxiety with social awareness and social motivation, standardized residuals showed two values bigger than two standard deviations from the mean, but these were not significantly deviated. Mahalanobis and Cook's Distance values were

below 15 and below 1. In the regressions with social cognition, social communication, and autistic preoccupations, one value in the standardized residuals was bigger than two standard deviations from the mean. However, Mahalanobis and Cook's Distance were also within the boundaries for influential cases. Because all outliers were due to extreme, but not impossible, non-influential low or high scores on the measures, no outliers were removed from the dataset.

Using the Q-Q plots, normality checks revealed that two standardized residuals showed a slight negative skew. This was the case for the SRS-2 subscales of social communication and autistic preoccupations. According to the central limit theorem, however, normality would almost certainly not be a problem, as normality would increase with an increasing sample size (Field, 2013; B. Bocanegra, personal communication, January 4 2020) and, therefore, it was decided to continue with these analyses.

No regressions showed any problems with linearity or homogeneity of variance. The independent variables social cognition, social communication, and especially social motivation were significantly correlated to the dependent variable of COVID-19 anxiety ($p$ = .015, $p$ = .038, and $p$ = .006, respectively).

**Hypotheses testing**

To test the hypothesis that a child that is more anxious about the COVID-19 pandemic will also experience more severe ASD symptoms, linear regressions were performed. The score on the COVID-19 anxiety measure by Generation R served as the continuous independent variable, and the SRS-2 subscales (Roeyers et al., 2011) as the continuous dependent variables.

Using every subscale of the SRS-2 separately clarified which aspects of ASD were mainly linked to COVID-19 anxiety, and gave more specific answers about the meaning and strength

of this relationship. It allowed a more in-depth view of the components of ASD symptomology, specifically that of social functioning.

To test the hypothesis that the relationship between anxiety about the COVID-19 pandemic and the severity of ASD symptoms will be moderated by general parental anxiety, moderation analyses were performed. The independent and dependent variables were the same as before, and the BSI general parental anxiety score (Derogatis, 1993; De Beurs, 2008) was included as a continuous moderator variable. The analyses were performed using version 4.1 of the PROCESS software in SPSS (Hayes, 2022). In its main menu, PROCESS was asked to run model 1. In its "options" menu, it was asked to center all variables that define products and to produce code for visualizing interactions. The code allowed for the construction of graphs for a simple slopes analysis in the case of significant interactions, as this gives a more visual representation of the relationship between the X and Y on three different levels of the moderator, compared to using (only) the Johnson-Neyman output.

## Results

Regression analyses revealed that contrary to the first hypothesis, COVID-19 anxiety was not significantly associated with social awareness deficits, social communication deficits, or the severity of autistic preoccupations. However, COVID-19 anxiety was significantly associated with the severity of social cognition deficits and social motivation deficits. The results mean that there was a relationship between more anxiety about the pandemic and more severe problems in children with ASD regarding their social cognition and social motivation. It also means that social awareness, social communication, and autistic preoccupations were unrelated to how anxious children with ASD are about COVID-19. The results of the analyses can be found in Table 4.

**Table 4**

*Results of the Regression Analyses per SRS-2 Subscale*

| | F | p | $R^2$ | $R^2_{adjusted}$ |
|---|---|---|---|---|
| Social Awareness | .017 | .896 | .00 | -.02 |
| Social Cognition | 4.963 | .031* | .10 | .08 |
| Social Communication | 3.287 | .076 | .07 | .05 |
| Social Motivation | 6.849 | .012* | .01 | .01 |
| Autistic Preoccupations | 1.758 | .191 | .04 | .02 |

*Note.* Degrees of Freedom = 46

*$p < .05$

Moderation analyses revealed that contrary to the second hypothesis, parental anxiety did not moderate the relationship between anxiety about the COVID-19 pandemic and the severity of the core ASD symptoms. This implies that the amount of general parental anxiety does not affect the relationship between COVID-19 anxiety and ASD symptomatology in their children. As no interaction effects were significant, no simple slopes analyses were performed. The results of the moderation analyses can be found in Table 5.

**Table 5**

*Results of Parental Anxiety as Moderator of COVID-19 Anxiety on the SRS-2 Subscales*

| | | b | SE b | t | p |
|---|---|---|---|---|---|
| Social Awareness | COVID-19 Anxiety | -0.02 | 0.137 | -0.13 | .893 |
| | | [ -0.29, 0.26] | | | |
| | Parental BSI Scores | 0.01 | 0.141 | 0.08 | .938 |
| | | [-0.27, 0.30] | | | |
| | Interaction | -0.01 | 0.015 | -0.40 | .691 |
| | | [-0.04, 0.02] | | | |
| Social Cognition | COVID-19 Anxiety | 0.27 | 0.114 | 2.34 | <.05 |
| | | [0.04, 0.50] | | | |
| | Parental BSI Scores | 0.35 | 0.118 | 2.98 | <.05 |
| | | [0.11, 0.59] | | | |
| | Interaction | -0.00 | 0.012 | -0.27 | .789 |
| | | [-0.03, 0.02] | | | |
| Social Communication | COVID-19 Anxiety | 0.26 | 0.136 | 1.93 | .060 |
| | | [-0.01, 0.54] | | | |
| | Parental BSI Scores | 0.44 | 0.140 | 3.12 | <.05 |
| | | [0.15, 0.72] | | | |
| | Interaction | -0.01 | 0.015 | -0.72 | .478 |
| | | [-0.04, 0.02] | | | |
| Social Motivation | COVID-19 Anxiety | 0.36 | 0.133 | 2.67 | <.05 |
| | | [0.09, 0.62] | | | |

| | | | | | |
|---|---|---|---|---|---|
| | Parental BSI Scores | 0.24 | 0.137 | 1.78 | .082 |
| | | [-0.03, 0.52] | | | |
| | Interaction | -0.02 | 0.014 | -1.17 | .247 |
| | | [-0.05, 0.01] | | | |
| | | b | SE b | t | p |
| Autistic Preoccupations | COVID-19 Anxiety | 0.38 | 0.283 | 1.34 | .187 |
| | | [-0.19, 0.95] | | | |
| | Parental BSI Scores | 0.65 | 0.292 | 2.23 | <.05 |
| | | [0.06, 1.24] | | | |
| | Interaction | -0.03 | 0.030 | -0.89 | .377 |
| | | [-0.09, 0.03] | | | |

As descriptive statistics of the sample revealed that only four of the 48 parents was the father of the child (8.3%), there was an unequal distribution in the amount of mothers and fathers that report on the symptoms and behavior of their child. It was therefore important to investigate the possible effects on the results. To check for any possible effects of whether the measures of this study were completed by mother or father, an independent samples T-test was performed on the data for the subscales of the SRS-2 as well as the COVID-19 anxiety measure. These tests showed no significant differences in any of the SRS-2 subscales or the COVID-19 anxiety measure between mother report or father report, and, therefore, it can be assumed that the gender of the parent did not significantly influence the results of the present study. The results of this T-test can be found in Table 6 and Table 7.

**Table 6**

*Statistics for Independent Samples T-Test*

| | | Mean | St. Deviation |
|---|---|---|---|
| Social Awareness | Mother | 58.29 | 8.475 |
| | Father | 59.50 | 15.264 |
| Social Cognition | Mother | 73.69 | 8.461 |
| | Father | 76.75 | 7.228 |
| Social Communication | Mother | 70.79 | 9.757 |
| | Father | 63.00 | 4.546 |
| Social Motivation | Mother | 67.43 | 9.971 |
| | Father | 62.50 | 6.137 |
| Autistic Preoccupations | Mother | 79.02 | 19.974 |
| | Father | 73.25 | 13.696 |
| COVID-19 Anxiety | Mother | 50.46 | 1.553 |
| | Father | 41.43 | 2.498 |

**Table 7**

*Results of the Independent Samples T-Test*

| | $F^a$ | t | p (2-tailed) |
|---|---|---|---|
| Social Awareness | 2.703 | -0.255 | .800 |
| Social Cognition | 0.348 | -0.698 | .489 |
| Social Communication | 2.268 | 1.567 | .124 |
| Social Motivation | 1.785 | 0.965 | .340 |

| | | | |
|---|---|---|---|
| Autistic Preoccupations | 0.762 | 0.563 | .577 |
| COVID-19 Anxiety | 2.822 | 1.761 | .085 |

*Note.* Degrees of Freedom = 44

*a*Equal variances assumed

## Discussion

Given that children with ASD are vulnerable during the COVID-19 pandemic due to their high prevalence of comorbid anxiety (Van Steensel et al., 2011; McVey, 2019), more anxiety about the COVID-19 pandemic than typically developing peers (Pearcey et al., 2020), and possible worsening of ASD symptoms at the hand of their anxiety (Duvekot et al., 2018; Turner et al., 2023), this study aimed to add to the growing pool of knowledge of the consequences of the pandemic on children with ASD. It did so by investigating whether COVID-19-specific anxiety would affect ASD symptoms in children. Additionally, given the increasing amount of studies showing that parental distress or anxiety "spills over" to their child (Eshraghi et al., 2022), also during the pandemic, this study investigated this topic in relation to the possible moderating effect of parent anxiety on the relationship between child COVID-19 anxiety and ASD symptom severity. The results of this study show that more anxiety is only associated with more severe problems with social cognition and social motivation, two components of the core ASD symptom of social deficits. This means that children who experience more anxiety about the pandemic are also more likely to experience more problems with perceiving and interpreting social information (Morrison et al., 2020), evaluating the behavior of others based on hypothesized mental states (Tager-Flusberg, 2007), and experience less motivation to engage in social interactions to achieve acceptance or approval of others (Rudy, 2020). No association is found with the other components of social deficits or the core symptom of restricted, repetitive patterns in behavior, interests and activities. In addition, the results of the moderation analysis show that parental anxiety does

not function as a moderator in the relationship between COVID-19 anxiety and ASD symptom severity in this sample.

Social cognition deficits comprise difficulties inferring, identifying, and interpreting other people's emotional states, thoughts, and intentions (Morrison et al., 2020). Some argue that social cognition also entails the perception of the self, which is another integral part of processing the social world (Beer & Ochsner, 2006). Children with ASD generally have a more detail-focused perception, which limits their ability to focus on socially relevant details and may lead to misinterpretations of social situations (Van Pelt et al., 2022). Social cognition is strongly linked to Theory of Mind, which refers to the use of dedicated cognitive systems to evaluate the behavior of others based on their speculated likely mental state (Tager-Flusberg, 2007). Generally, children with ASD have difficulties understanding that the beliefs of others about a situation can be false and different from their own beliefs, and have difficulty shifting perspective (Baron-Cohen et al., 1985). Previous research about the link of social cognition with anxiety shows mixed results. Similar results to the present study were found by Schoultz (2016), who discovered a trend toward significance for the relationship between anxiety and social cognition difficulties, using the SRS as their measurement. Pearcey et al. (2021) found that more social anxiety was associated with more social cognition difficulties in children with ASD. However, their study focused on social anxiety rather than general or COVID-19-specific anxiety. Factor et al. (2017) explain that anxiety may decrease the ability to comprehend social cues correctly, increasing difficulties in social cognition. In the presence of the COVID-19 pandemic, it can be speculated that this interpretation is even more difficult due to the rapidly changing social world and expectations, as well as facial covering with protective masks, that hinder the interpretation of facial expressions, such as was found by Ventura et al. (2023). Another explanation for the relationship between anxiety and lower social cognition skills comes from a study on social

isolation during the pandemic with neurotypical youth, which states that reduced contact with friends was related to less positive bias in emotion recognition, and the frequency of contact with friends was related to reduced positive bias for attention to emotional faces (Bland et al., 2022).

The present study also found a significant association between COVID-19 anxiety and social motivation. Children with social motivation difficulties experience fewer incentives to engage in social interactions to achieve acceptance or approval of others, and experience such outcomes as less rewarding or unrewarding. They might, for example, not imitate their peers' behavior or look for cues to achieve social inclusion (Rudy, 2020). These findings are supported on a neurological level, as atypical activation of the reward circuitry exists in people with ASD (Dalton et al., 2005). The results of the present study are consistent with existing research, which shows significant relationships between social anxiety and social motivation deficits (Briot et al., 2020; Factor et al., 2016). This relationship may exist because avoiding social situations reinforces low social motivation (Swain et al., 2015). Additionally, children with ASD that experience more anxiety, as shown by higher levels of cortisol reactivity, reported less social motivation during play (Briot et al., 2020). During the COVID-19 pandemic, opportunities for social contact were even lower than usual, which might be the reason that social motivation deficits are maintained or worsened, as the child has no opportunities to encounter their fears and reinforcement continues (Factor et al., 2017; Swain et al., 2015).

This study did not find a relationship between anxiety and social awareness difficulties, social communication difficulties, and autistic preoccupations. Social awareness concerns the ability to pick up on social cues, such as being aware of others and their emotions, and one's role in interactions (Schoultz, 2016). In accordance with the present study, Briot et al. (2020) did not find a significant association between social anxiety and social awareness as

measured with the SRS-2. Again, however, that study investigates social anxiety instead of COVID-19-specific anxiety. One possible explanation for the findings comes from a study with children with varying disabilities during the pandemic, who experienced increased social awareness during the pandemic as they learned more about other people, the pandemic in general, as well as all its implications (Toste et al., 2021). In addition, interestingly, some children with "high functioning autism" prefer remote learning, because they struggle with the implicit behaviors, procedures, norms, and values at school (Reicher, 2020). The anxiety of not understanding the "hidden curriculum" explains their relative enjoyment of learning at home, with fewer worries over social situations, and less sensory overload (Reicher, 2020). The fact that they did not have to feel the anxiety and insecurity while working at home may be another explanation for the lack of relationship between COVID-19 anxiety and social awareness.

Social communication is all about expressive communication in a reciprocal context, such as conversational skills, relating to others, and appropriate communication manners (Schoultz, 2016). As explained by Morris et al. (2023), it may be that other factors than anxiety impact changes in social communication, such as simply the fact that children have less contact with peers and less face-to-face support. Renzo et al. (2020) even reported that, although general symptomatology worsened in children with ASD, their communicative relationships with parents improved during COVID-19. The reduced demands of social participation can also alleviate social and anticipatory anxiety before attending school (Kalvin et al., 2021). In a study by Oomen et al. (2021), adults with ASD felt relieved, as the world was quieter, reducing sensory and social overload.

Autistic preoccupations include stereotypical behaviors or restricted interests (Schoultz, 2016). This study did not find a significant association between anxiety and autistic preoccupations, even though it was expected that preoccupations might be a way to relieve

anxiety during the pandemic, given the research by, among others, Lang et al. (2015) and Sukhodolsky et al. (2008). However, Factor et al. (2016) give a possible explanation for the current findings. Social motivation was significantly related to anxiety in the present study, and Factor et al. (2016) explain that an increase in anxiety may lead to less social motivation, which causes children with ASD to seek out non-social stimuli instead of social ones, resulting in less need for repetitive or stereotypical behaviors or preoccupations. They also found that more anxiety was related to more insistence on sameness. However, this relationship was partially mediated by social motivation. Indeed, previous research suggests that especially insistence on sameness, one part of autistic preoccupations, would be related to anxiety, as more anxiety would give rise to more insistence on sameness behaviors (Briot et al., 2020). This might explain why anxiety is not significantly related to the whole of the autistic preoccupations symptom.

In the present study, parental anxiety was not a moderator in the relationship between COVID-19 anxiety and symptom severity, even though this was expected based on research by Rodriguez et al. (2019) and Eshraghi et al. (2022), among others, which explain that more parent stress leads to more severe ASD symptoms in children, possibly because parent anxiety "spills over" to the child, or because the child is prone to imitate the parent (Eshraghi et al., 2022). One possible explanation for the lack of a moderation effect is that the relationship may go in a different direction, such that child ASD symptoms predict parent anxiety, as Bitsika & Sharpley (2017) found. The lack of association does mean that, in this sample, the amount of anxiety of a parent does not strengthen the relationship between child anxiety and ASD symptoms, which could be good news for children that are already experiencing many difficulties adjusting to the pandemic situation.

**Strengths and Limitations**

The strengths of this study are the separate analyses on all different SRS-2 subscales, which allowed for a more in-depth view of the specific influence of COVID-19 anxiety on all aspects of ASD symptoms. Furthermore, this study has been the first to investigate these variables together, to allow for more extensive research on the effects of COVID-19 anxiety on the functioning of children with ASD. This study was limited by a small research sample (N = 48). Based on only one predictor per analysis, the sample size ideally should have been 387 to detect a small effect or 55 to detect a medium size effect (Field, 2013). A small sample size can lead to unreliable data and undermine the internal and external validity (Faber & Fonseca, 2014). Lastly, the questionnaire by Generation R, the measure used to quantify the amount of COVID-19 anxiety, is a new instrument of which the validity and reliability are still to be determined.

**Clinical Implications**

This study has demonstrated that there could be a link between anxiety about the COVID-19 pandemic and the core symptoms of children with ASD, specifically when it comes to social cognition and social motivation. However, it hopes to function primarily as part of the starting point for examining the effects of the pandemic, investigating the precise effects that this uncertain time has had on vulnerable groups like children with ASD, and contributing to a clear overview of issues that this group faces.

According to the results of this study, children with ASD that experience relatively high levels of anxiety about COVID-19 could benefit from interventions focused on alleviating that anxiety, for which preliminary research shows a role of hope-focused support (Mirhosseini et al., 2020). To combat the worsening of social cognition issues and to improve their skills in this field, anxious children with ASD could benefit from multiple available therapies, including the SENSE Theater intervention (Corbett et al., 2019), a virtual reality social cognition training (VR-SCT, Didehbani et al., 2016), or a group-based cognitive-

behavioral intervention called Social Cognition and Interaction Training, the feasibility of which was supported with high functioning autistic adults (Turner-Brown et al., 2008). Additionally, treatments such as Pivotal Response Treatment (PRT, Voos et al., 2013) have been brought forward in the literature to counter social motivation deficits.

Once the consequences of this pandemic on children with ASD are more evident, appropriate interventions can be set up to properly support those in need, including parents and professionals, to improve functioning during challenging times and potentially mitigate long-term consequences. Additionally, findings such as those of this study should be used to determine adequate policies that are research-based and take the unique needs of children with neurodevelopmental disorders like ASD into account. Once a more precise image of the effects of the pandemic on children with ASD is constructed, guidelines can be developed that guide parents, schools, and care providers to proper and fitting care in line with the identified needs.

**Conclusion**

This study has found a relationship between COVID-19 anxiety and social cognition and social motivation deficits in children with ASD. No relationship was found with other components of ASD symptomatology. Parental anxiety was not a moderator in these analyses. The COVID-19 pandemic has proven to be a very challenging time for everyone. However, it is crucial to understand the additional difficulties experienced by vulnerable groups, such as children with ASD, to minimize the consequences on their symptom severity and, therefore, their general quality of life. Additional research must confirm and show the exact areas where children with ASD experience difficulties, so appropriate interventions, policies, and support can be implemented.

## References

Altable, M. (2020, May 14). *Child and Adult Autism Spectrum Disorder in COVID-19 Pandemic*. Qeios. https://www.qeios.com/read/8ZRWPM

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Amorim, R., Catarino, S., Miragaia, P., Ferreras, C., Viana, V., & Guardiano, M. (2020). The impact of COVID-19 on children with Autism Spectrum Disorder. Impacto de la COVID-19 en niños con trastorno del espectro autista. *Revista de neurologia, 71*(8), 285–291. https://doi.org/10.33588/rn.7108.2020381

Asbury, K., Fox, L., Deniz, E., Code, A., & Toseeb, U. (2021). How is COVID-19 affecting the mental health of children with special educational needs and disabilities and their families? *Journal of Autism and Developmental Disorders, 51*(5), 1772–1780. https://doi.org/10.1007/s10803-020-04577-2

Asbury, K., & Toseeb, U. (2023). A longitudinal study of the mental health of autistic children and adolescents and their parents during COVID-19: Part 2, qualitative findings. *Autism, 27*(1), 188-199. https://doi.org/10.1177/13623613221086997

Asperger, H. (1944). Die “Autistischen Psychopaten” im kindesalter. *Archiv für Psychiatrie und Nervenkrankheiten, 177,* 76–136. https://doi.org/10.1007/BF01837709

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a “theory of mind”? *Cognition, 21*(1), 37-46. https://doi.org/10.1016/0010-0277(85)90022-8

Beer, J. S., & Ochsner, K. N. (2006). Social cognition: A multi level analysis. *Brain Research, 1079*(1), 98-105. https://doi.org/10.1016/j.brainres.2006.01.002

Bitsika, V., & Sharpley, C. F. (2017). The association between parents’ ratings of ASD symptoms and anxiety in a sample of high-functioning boys and adolescents with Autism

Spectrum Disorder. *Research in Developmental Disabilities, 63,* 38-45. https://doi.org/10.1016/j.ridd.2017.02.010

Bland, A. R., Roiser, J. P., Mehta, M. A., Sahakian, B. J., Robbins, T. W., & Elliott, R. (2022). The impact of COVID-19 social isolation on aspects of emotional and social cognition. *Emotion and Cognition, 36,* 49-58. https://doi.org/10.1080/02699931.2021.1892593

Briot, K., Jean, F., Jouni, A., Geoffray, M., Moal, M. L., Umbricht, D., Chatham, C., Murtagh, L., Delorme, R., Bouvard, M., Leboyer, M., & Amestoy, A. (2020). Social anxiety in children and adolescents with Autism Spectrum Disorders contribute to impairments in social communication and social motivation. *Frontiers in Psychiatry, 11.* https://doi.org/10.3389/fpsyt.2020.00710

Cashin, A., & Yorke, J. (2018). The relationship between anxiety, external structure, behavioral history and becoming locked into restricted and repetitive behaviors in Autism Spectrum Disorder. *Issues in Mental Health Nursing, 39*(6), 533-537. https://doi.org/10.1080/01612840.2017.1418035

Catalano, D., Holloway, L., & Mpofu, E. (2018). Mental health interventions for parent carers of children with Autistic Spectrum Disorder: Practice guidelines from a Critical Interpretive Synthesis (CIS) systematic review. *International Journal of Environmental Research and Public Health, 15*(2), 341. https://doi.org/10.3390/ijerph15020341

Chang, Y., Quan, J., & Wood, J. J. (2012). Effects of anxiety disorder severity on social functioning in children with Autism Spectrum Disorders. *Journal of Developmental and Physical Disabilities, 24,* 235-245. https://doi.org/10.1007/s10882-012-9268-2

Colizzi, M., Sironi, E., Antonini, F., Ciceri, M. L., Bovo, C., & Zoccante, L. (2020). Psychosocial and behavioral impact of COVID-19 in Autism Spectrum Disorder: An online parent survey. *Brain Sciences, 10,* 341. https://doi.org/10.3390/brainsci10060341

Corbett, B. A., Ioannou, S., Key, A. P., Coke, C., Muscatello, R., Vandekar, S., & Muse, I. (2019). Treatment effects in social cognition and behavior following a theater-based intervention for youth with autism. *Developmental Neuropsychology, 44*(7), 481-494. https://doi.org/10.1080/87565641.2019.1676244

Corbett, B., A., Muscatello, R. A., Klemencic, M. E., & Schwarzman, J. M. (2021). The impact of COVID-19 on stress, anxiety, and coping in youth with and without autism and their parents. *Autism Research, 14*(7), 1496-1511. https://doi.org/10.1002/aur.2521

Cucinotta, D., & Vanelli, M. (2020). WHO declares COVID-19 a pandemic. *Acta Biomedica, 91*(1), 157-160. https://doi.org/10.23750/abm.v91i1.9397

Dalton, K. M., Nacewicz, B. M., Alexander, A. L., & Davidson, R. J. (2005). Gaze-fixation, brain activation, and amygdala volume in unaffected siblings of individuals with autism. *Biological Psychiatry, 61*(4), 512–520. https://doi.org/10.1016/j.biopsych.2006.05.019

De Beurs, E. (n.d.). *Brief Symptom Inventory* [Powerpoint slides]. Trimbos-instituut. https://assets-sites.trimbos.nl/docs/8601fb9a-58f7-43bb-b4d7-acb9d9c499b5.pdf

De Beurs, E. (2008). Brief symptom inventory handleiding. PITS B.V. https://www.pearsonclinical.nl/bsi-brief-symptom-inventory

Dekker, L. P., Hooijman, L. W. E., Louwerse, A., Visser, K., Bastiaansen, D., Ten Hoopen, L. W., De Nijs, P. F. A., Dieleman, G. C., Ester, W. A., Van Rijen, E. H. M., Truijens, F. L., & Van der Hallen, R. (2021). *The impact of COVID-19 on children and adolescents with Autism Spectrum Disorder and their families: A mixed methods study protocol.* [Unpublished manuscript]. Erasmus University Rotterdam.

Derogatis, L. R. (1993). *BSI brief symptom inventory: Administration, scoring, and procedures manual*. National Computer Systems. https://www.pearsonclinical.nl/bsi-brief-symptom-inventory

Didehbani, N., Allen, T., Kandalaft, M., Krawczyk, D., & Chapman, S. (2016). Virtual Reality Social Cognition Training for children with high functioning autism. *Computers in Human Behavior, 62,* 703-711. https://doi.org/10.1016/j.chb.2016.04.033

Duan, L., Shao, X., Wang, Y., Huang, Y., Miao, J., Yang, X., & Zhu, G. (2020). An investigation of mental health status of children and adolescents in China during the outbreak of COVID-19. *Journal of Affective Disorders.* https://doi.org/10.1016/j.jad.2020.06.029

Duvekot, J., Van der Ende, J., Verhulst, F. C., & Greaves-Lord, K. (2018). Examining bidirectional effects between the Autism Spectrum Disorder (ASD) core symptom domains and anxiety in children with ASD. *The Journal of Child Psychology and Psychiatry, 59*(3), 277-284. https://doi.org/10.1111/jcpp.12829

Eshraghi, A. A., Cavalcante, L., Furar, E., Alessandri, M., Eshraghi, R. S., Armstrong, F. D., & Mittal, R. (2022). Implications of parental stress on worsening of behavioral problems in children with autism during COVID-19 pandemic: "The spillover hypothesis". *Molecular Psychiatry, 27,* 1869-1870. https://doi.org/10.1038/s41380-021-01433-2

Faber, J., & Fonseca, L. M. (2014). How sample size influences research outcomes. *Dental Press Journal of Orthodontics, 19*(4), 27-29. https://doi.org/10.1590/2176-9451.19.4.027-029.ebo

Factor, R. S., Condy, E. E., Farley, J. P., & Scarpa, A. (2016). Brief report: Insistence on sameness, anxiety, and social motivation in children with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders, 46,* 2548-2554. https://doi.org/10.1007/s10803-016-2781-x

Factor, R. S., Ryan, S. M., Farley, J. P., Ollendick, T. H., & Scarpa, A. (2017). Does the presence of anxiety and ADHD symptoms add to social impairment in children with

Autism Spectrum Disorder? *Journal of Autism and Developmental Disorders, 47,* 1122-1134. https://doi.org/10.1007/s10803-016-3025-9

Field, A. (2013). *Discovering Statistics using IBM SPSS Statistics: 4th Edition.* SAGE.

Hayes, A. F. (2022). *PROCESS* (Version 4.1) [Computer software]. https://www.processmacro.org/download.html

Hosokawa, R., Kawabe, K., Nakachi, K., Yoshino, A., Horiuchi, F., & Ueno, S. (2021). Behavioral affect in children with Austism Spectrum Disorder during school closures due to the COVID-19 pandemic in Japan: A case-controlled study. *Developmental Neuropsychology*, 1-10. https://doi.org/10.1080/87565641.2021.1939350

Kalvin, C. B., Jordan, R. P., Rowley, S. N., Weis, A., Wood, K. S., Wood, J. J., Ibrahim, K., & Sukhodolsky, D. G. (2021). Conducting CBT for anxiety in children with Autism Spectrum Disorder during COVID-19 pandemic. *Journal of Autism and Developmental Disorders*. https://doi.org/10.1007/s10803-020-04845-1

Lang, M., Krátký, J., Shaver, J. H., Jerotijevic, D., & Xygalatas, D. (2015). Effects of anxiety on spontaneous ritualized behavior. *Current Biology, 25,* 1892-1897. https://doi.org/10.1016/j.cub.2015.05.049

Larkin, F., Meins, E., & Leekam, S. R. (2019). Predisposing factors for elevated restricted and repetitive behavior in typically developing toddlers. *Infancy, 24*(1), 24–42. https://doi.org/10.1111/infa.12264

Lidstone, J., Uljarevic, M., Sullivan, J., Rodgers, J., McConachie, H., Freeston, M., Le Couteur, A., Prior, M., & Leekam, S. (2014). Relations among restricted and repetitive behaviors, anxiety and sensory features in children with Autism Spectrum Disorders. *Research in Autism Spectrum Disorders, 8,* 82-92. https://doi.org/10.1016/j.rasd.2013.10.001

Martínez-González, A. E., Moreno-Amador, B., & Piqueras, J. A. (2021). Differences in emotional state and autistic symptoms before and during confinement due to the COVID-19 pandemic. *Research in Developmental Disabilities, 116,* 104038. https://doi.org/10.1016/j.ridd.2021.104038

Miniarikova, E., Vernhet, C., Peries, M., Loubersac, J., Picot, M., Munir, K., & Baghdadli, A. (2022). Anxiety and depression in parents of children with Autism Spectrum Disorder during the first COVID-19 lockdown: Report from the ELENA cohort. *Journal of Psychiatric Research, 149,* 344-351. https://doi.org/10.1016/j.jpsychires.2021.11.022

Mirhosseini, S., Dadgari, A., Basirinezhad, M. H., Mohammadpourhodki, R., & Ebrahimi, H. (2020). The role of hope to alleviate anxiety in COVID-19 outbreak among community dwellers: An online cross-sectional survey. *Annals of the Academy of Medicine, Singapore, 49*(10), 723-730. https://doi.org/10.47102/annals-acadmedsg.2020341

Morris, P. O., Hope, E., Foulsham, T., & Mills, J. P. (2023). Parent-reported social-communication changes in children diagnosed with Autism Spectrum Disorder during the COVID-19 pandemic in the UK. *International Journal of Developmental Disabilities, 69(*2), 211-225. https://doi.org/10.1080/20473869.2021.1936870

Morrison, K. E., DeBrabander, K. M., Jones, D. R., Ackerman, D. A., & Sasson, N. J. (2020). Social cognition, social skill, and social motivation minimally predict social interaction outcomes for autistic and non-autistic adults. *Frontiers in Psychology, 20.* https://doi.org/10.3389/fpsyg.2020.591100

Mutluer, T., Doenyas, C., & Genc, H. A. (2020). Behavioral implications of the Covid-19 process for Autism Spectrum Disorder, and individuals' comprehension of and reactions to the pandemic conditions. *Frontiers in Psychiatry, 11.* https://doi.org/10.3389/fpsyt.2020.561882

McVey, A. J. (2019). The neurobiological presentation of anxiety in Autism Spectrum Disorder: A systematic review. *Autism Research, 12,* 346-369. https://doi.org/10.1002/aur.2063

McVey, A. J., Schiltz, H. K., Haendel, A. D., Dolan, B. K., Willar, K. S., Pleiss, S. S., Karst, J. S., Carlson, M., Krueger, W., Murphy, C. C., Casnar, C. L., Yund, B., & Van Hecke, A. V. (2018). Social difficulties in youth with autism with and without anxiety and ADHD symptoms. *Autism Research, 11,* 1679-1689. https://doi.org/10.1002/aur.2039

Nederlandse Omroep Stichting. (2020a, January 9). *Mysterieuze longziekte in China lijkt nieuw virus.* https://nos.nl/artikel/2317906-mysterieuze-longziekte-in-china-lijkt-nieuw-virus.html

Oomen, D., Nijhof, A. D., & Wiersema, J. R. (2021). The psychological impact of the COVID-19 pandemic on adults with autism: A survey study across three countries. *Molecular Autism, 12.* https://doi.org/10.1186/s13229-021-00424-y

O'Sullivan, K., Clark, S., McGrane, A., Rock, N., Burke, L., Boyle, N., Joksimovic, N., & Marshall, K. (2021). A qualitative study of child and adolescent mental health during the COVID-19 pandemic in Ireland. *International Journal of Environmental Research and Public Health, 18*(3)*,* 1062. https://doi.org/10.3390/ijerph18031062

Pearcey, S., Gordon, K., Chakrabarti, B., Dodd, H., Halldorsson, B., & Creswell, C. (2021). Research review: The relationship between social anxiety and social cognition in children and adolescents: A systematic review and meta-analysis. *The Journal of Child Psychology and Psychiatry, 62*(7), 805-821. https://doi.org/10.1111/jcpp.13310

Pearcey, S., Shum, A., Waite, P., & Creswell, C. (2020, June 16). *Supplementary Report 03: Differences in pandemic anxiety, parent/carer stressors and reported needs between parent/carers of children with and without ASD; Change over time in mental health for children with ASD.* Co-SPACE Study.

http://cospaceoxford.org/wp-content/uploads/2020/07/Co-SPACE-supplementary-report-03.pdf

Qualtrics. (2021). *Qualtrics Survey Tool.* (December 2020). https://www.qualtrics.com

Reicher, D. (2020). Debate: Remote learning during COVID-19 for children with high functioning Autism Spectrum Disorder. *Child and Adolescent Mental Health, 4,* 263-264. https://doi.org/10.1111/camh.12425

Renzo, M. D., Castelbianco, F. B. D., Vanadia, E., Petrillo, M., D'Errico, S., Racinaro, L., & Rea, M. (2020). Parent-reported behavioural changes in children with Autism Spectrum Disorder during the COVID-19 lockdown in Italy. *Continuity in Education, 1,* 117–125. https://doi.org/10.5334/cie.20

Rodriguez, G., Hartley, S. L., & Bolt, D. (2019). Transactional relations between parenting stress and child autism symptoms and behavior problems. *Journal of Autism and Developmental Disorders, 49,* 1887-1898. https://doi.org/10.1007/s10803-018-3845-x

Roeyers, H., Thys, M., Druart, C., De Schryver, M., & Schittekatte, M. (2011). *SRS screeningslijst voor autismespectrumstoornissen, SRS.* Hogreve Uitgevers B.V. https://www.cotandocumentatie.nl/beoordelingen/b/14691/srs-screeningslijst-voor-autismespectrumstoornissen/

Roeyers, H., Thys, M., Druart, C., De Schryver, M., & Schittekatte, M. (2015). Bijlage A. Nederlandse Populatienormen. In *SRS-2. Screeningslijst voor autismespectrumstoornissen. Handleiding.* (pp. 58-69). Hogreve Uitgevers B.V. https://www.hogrefe.com/nl/shop/srs-2-screeningslijst-voor-autismespectrumstoornissen.html#1+1

Rosen, Z., Weinberger-Litman, S. L., Rosenzweig, C., Rosmarin, D. H., Muennig, P., Carmody, E. R., Rao, S. T., & Litman, L. (2020). *Anxiety and distress among the first*

*community quarantined in the U.S. due to COVID-19: Psychological implications for the unfolding crisis.* https://doi.org/10.31234/osf.io/7eq8c

Rudy, L. J. (2020, April 17). *social motivation and autism: social motivation is key for typical learning and growth.* Verywell Health. https://www.verywellhealth.com/social-motivation-and-autism-4176314

Schoultz, P. (2016). Who responds to cognitive-behavioral group treatment? Associations between anxiety symptom reduction and autism symptom domains. P*roQuest Dissertations & Theses Global.* https://www.proquest.com/dissertations-theses/who-responds-cognitive-behavioral-group-treatment/docview/1800752274/se-2

Sukhodolsky. D. G., Scahill, L., Gadow. K. D., Arnold, E., Aman, M. G., McDougle, C. J., McCracken, J. T., Tierney, E., White, S. W., Lecavalier, L., & Vitiello, B. (2008). Parent-rated anxiety symptoms in children with pervasive developmental disorders: Frequency and association with core autism symptoms and cognitive functioning. *Journal of Abnormal Child Psychology, 36,* 117-128. https://doi.org/10.1007/s10802-007-9165-9

Swain, D., Scarpa, A., White, S., & Laugeson, E. (2015). Emotion dysregulation and anxiety in adults with ASD: Does social motivation play a role? *Journal of Autism and Developmental Disorders, 45*(12), 3971-3977. https://doi.org/10.1007/s10803-015-2567-6

Tager-Flusberg, H. (2007). Evaluating the Theory-of-Mind hypothesis of autism. *Association for Psychological Science, 16*(6), 311-315. https://doi.org/10.1111/j.1467-8721.2007.00527.x

Tarbox, C. M., Silverman, E. A., Chastain, A. N., Little, A., Bermudez, T. L., & Tarbox, J. (2020). Taking ACTion: 18 simple strategies for supporting children with autism during

the COVID-19 pandemic. *Behavior Analysis in Practice.* https://doi.org/10.1007/s40617-020-00448-5

Toste, J. R., Raley, S. K., Toews, S. G., Shogren, K. A., & Coelho, G. (2021). "Eye opening and chaotic": Resilience and self-determination of secondary students with disabilities amidst the COVID-19 pandemic. *Journal of Education for Students Placed at Risk (JESPAR), 26*(2), 157-183. https://doi.org/10.1080/10824669.2021.1906248

Turner-Brown, L. M., Perry, T. D., Dichter, G. S., Bodfish, J. W., & Penn, D. L. (2008). Brief report: Feasibility of Social Cognition and Interaction Training for adults with high functioning autism. *Journal of Autism and Developmental Disorders, 38*(9), 1777-1784. https://doi.org/10.1007/s10803-008-0545-y

Turner, K. M., Weiss, J. A., Howe, S. J., Sanguino, H., Kerns, C. M., Ames, M. E., & McMorris, C. A. (2023). Autistic characteristics and mental health symptoms in autistic youth during the first COVID-19 wave in Canada. *Autism Research,* 1-15. https://doi.org/10.1002/aur.2914

Van Pelt, B. J., Nijman, S. A., van Haren, N. E. M., Veling, W., Pijnenborg, G. H. M., Van Balkom, I. D. C., Landlust, A. M., & Greaves-Lord, K. (2022). Dynamic Interactive Social Cognition Training in Virtual Reality (DiSCoVR) for adults with Autism Spectrum Disorder: A feasibility study. *Research in Autism Spectrum Disorders, 96,* 102003. https://doi.org/10.1016/j.rasd.2022.102003

Van Steensel, F. J. A., Bogels, S. M., & Perrin, S. (2011). Anxiety disorders in children and adolescents with autistic spectrum disorders: A meta-analysis. *Clinical Child and Family Psychology Review, 14*, 302–317. https://doi.org/10.1007/s10567-011-0097-0

Vasa, R. A., Singh, V., Holingue, C., Kalb, L. G., Jang, Y., & Keefer, A. (2021). Psychiatric problems during the COVID-19 pandemic in children with Autism Spectrum Disorder. *Autism Research, 14*(10), 2113-2119. https://doi.org/10.1002/aur.2574

Ventura, M., Innamorato, F., Palmisano, A., Cicinelli, G., Nobile, E., Manippa, V., Keller, R., & Rivolta, D. (2023). Investigating the impact of disposable surgical face-masks on face identity and emotion recognition in adults with Autism Spectrum Disorder. *Autism Research, 16,* 1063-1077. https://doi.org/10.1002/aur.2922

Voos, A. C., Pelphrey, K. A., Tirrell, J., Bolling, D. Z., Van der Wyk, B., Kaiser, M. D., McPartland, J. C., Volkmar, F. R., & Ventola, P. (2013). Neural mechanisms of improvement in social motivation after Pivotal Response Treatment: Two case studies. *Journal of Autism and Developmental Disorders, 43,* 1-10. https://doi.org/10.1007/s10803-012-1683-9

Wigham, S., Rodgers, J., South, M., McConachie, H., & Freeston, M. (2015). The interplay between sensory processing abnormalities, intolerance of uncertainty, anxiety and restricted and repetitive behaviours in Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders, 45,* 943-952. https://doi.org/10.1007/s10803-014-2248-x

## Appendix A

Generation R COVID-19 Anxiety Questionnaire

CORONA – anxiety (GenR) – adapted to be anxiety of child (12+)

Time needed: 3 minutes

Below are several questions about how your child experiences the COVID-19-crisis and related worries.

Questions in bold are those used in the current study.

| Question | Values |
|---|---|
| **How worried has your child been in the last 7 days about the corona crisis?** | Not worried<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>Extremely worried |
| My child worries because of the COVID-19 pandemic about: | |
| **Getting ill himself/herself** | Never<br>Almost never<br>Sometimes<br>Often<br>Always or almost always |
| **Someone close or someone in their environment getting ill** | Never<br>Almost never<br>Sometimes<br>Often<br>Always or almost always |
| If almost never/sometimes/often/always or almost always is selected | Sibling<br>Parent<br>Other, namely [box] |
| **That I or my family will struggle financially** | Never<br>Almost never<br>Sometimes<br>Often |

| | |
|---|---|
| | Always or almost always |
| **That it will take a long time for daily life becoming normal again** | Never<br>Almost never<br>Sometimes<br>Often<br>Always or almost always |
| **That he/she cannot see his/her family or friends** | Never<br>Almost never<br>Sometimes<br>Often<br>Always or almost always |
| Other reason, namely [box]: | Never<br>Almost never<br>Sometimes<br>Often<br>Always or almost always |
| What precautions does your child take to prevent the coronavirus from spreading? | Frequently washing hands<br>Using hand-desinfectant<br>Social distancing or keeping a physical distance to others (other than members of the household)<br>Keeping a physical distance to others including members of the household<br>Covering the nose and mouth in public<br>Avoiding public transport<br>Avoiding traveling in general<br>Self-quarantine<br>Other, namely [box]: |
| In the past 7 days, where did your child get information and advice from? | Media (paper, TV, radio)<br>Health organizations (government, RIVM, WHO)<br>Social media (facebook, twitter, instagram)<br>Family and friends<br>Other |
| **Since the outbreak of the corona crisis, my child sees** | Disagree completely |

| | |
|---|---|
| **others in his/her environment, such as people nearby or in shops, as a threat to his/her well-being.** | Disagree a little<br>Slightly agree<br>Agree a little<br>Agree completely |
| **My child had confidence in the Dutch government's approach during the corona crisis.** | Completely no trust<br>Not much trust<br>A little trust<br>Much trust<br>Very much trust |
| How optimistic is your child that the corona crisis will be over (soon) in the Netherlands? | Not at all<br>A little<br>Moderately<br>Very<br>Extremely |