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## RESEARCH ARTICLE

# Loneliness in daily life: A comparison between youths with autism spectrum disorders and 22q11.2 deletion syndrome (22q11DS)

Clémence Feller<sup>1</sup>  | Laura Ilen<sup>1</sup>  | Stephan Eliez<sup>2,3</sup> | Maude Schneider<sup>1</sup>

<sup>1</sup>Clinical Psychology Unit for Intellectual and Developmental Disabilities, Faculty of Psychology and Educational Sciences, University of Geneva, Geneva, Switzerland

<sup>2</sup>Developmental Imaging and Psychopathology Lab Research Unit, Faculty of Medicine, University of Geneva, Geneva, Switzerland

<sup>3</sup>Department of Genetic Medicine and Development, Faculty of Medicine, University of Geneva, Geneva, Switzerland

## Correspondence

Clémence Feller, Clinical Psychology Unit for Intellectual and Developmental Disabilities, Faculty of Psychology and Educational Sciences, University of Geneva, 40, Boulevard du Pont-d'Arve, 1205 Geneva, Switzerland.  
Email: [clemence.feller@unige.ch](mailto:clemence.feller@unige.ch)

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## Abstract

Loneliness is a negative emotional experience that can stem from a gap between desires and the reality of social relationships. It is also a predictor of mental health. Loneliness is therefore important to investigate in neurodevelopmental populations known for having difficulties in the social sphere. This co-registered study involved 48 youths with autism spectrum disorders (ASD), 54 youths with 22q11.2 deletion syndrome (22q11DS) and 65 typically developing youths (TD) aged 12–30. State loneliness was assessed with an ecological momentary assessment. Paper–pencil questionnaires assessing attitude toward aloneness, trait loneliness, and mental health, were completed by the youths and their caregivers. A comparable level of state loneliness between clinical groups and TD were found, with greater loneliness when alone than in a social context. Clinical groups showed a greater intra-individual variability. Both individuals with ASD and 22q11DS revealed a greater affinity toward being alone than TD, but only individuals with ASD reported greater trait loneliness. However, no significant association was found between attitude toward aloneness, trait and state loneliness. Emotional reactivity to loneliness was different between the clinical groups. Self-reported mental health only was associated with loneliness in the clinical groups. These results provide new insights into the understanding of loneliness in these clinical populations and have an impact on clinical care by highlighting the need to remain vigilant when encountering youths who report feeling lonely, and that these youths need to be supported in developing their social network, which appears to be a protective factor against loneliness.

## Lay Summary

This study underlines the importance of drawing up social profiles specific to each population in order to adjust care to the difficulties encountered. Loneliness must be taken into account, as it is associated with mental health fragility and greater emotional reactivity in youths with ASD. However, aloneness can also be positively appreciated, and need not necessarily be seen as an alarming factor: its valence must therefore be investigated. This work also highlights the discrepancy between fundamental (traits) and context-dependent (state) characteristics, drawing attention to the importance of the environment.

## KEYWORDS

attitude toward aloneness, ecological momentary assessment, emotional reactivity, mental health, neurodevelopmental disorders, state loneliness, trait loneliness

## INTRODUCTION

Loneliness can be described as a negative emotional experience (Lay et al., 2019) but also as a gap between desires and reality in social relationships according to the social cognitive discrepancy theory (Plau & Perlman, 1982). Over the course of life, typically developing individuals (TD) encounter several periods of vulnerability to loneliness (Richard et al., 2017), adolescence being one of them (Danneel, Maes, Vanhalst, et al., 2018). Adolescence and early adulthood represent important life stages for the study of loneliness, notably because loneliness can lead to negative consequences during adulthood (Kwan et al., 2020). Loneliness has indeed been described as a predictor of mental health difficulties, such as depression (Elmer et al., 2020; Hedley et al., 2018) and social anxiety (Lim et al., 2016; van Roekel et al., 2015), and adolescence is a particularly sensitive period for the development of mental health issues (Roach, 2018).

Some adolescents and young adults, such as youths with neurodevelopmental disorders, are at even higher risk of experiencing mental health difficulties. Indeed, it was found that individuals with autism spectrum disorders (ASD)—a neurodevelopmental disorder affecting 1% of individuals that is characterized by impairments in communication and social interactions as well as by repetitive and restrictive interests and behaviors—experience significantly more mood and anxiety issues than the general population (Hossain et al., 2020; Schiltz et al., 2021; Zeidan et al., 2022). It was also reported that youths with 22q11.2 deletion syndrome (22q11DS) are at increased risk of developing mental health issues (Schneider et al., 2014). This rare genetic syndrome, resulting from a 1.5 to 3 megabase deletion on the long arm of chromosome 22 and affecting 1:2148 live births (Blagojevic et al., 2021), is associated with a high prevalence of psychiatric comorbidities such as anxiety and mood disorders as well as psychotic symptoms (Schneider et al., 2014). In addition to their vulnerability in terms of mental health, these two populations are also both characterized by significant social impairments. Indeed, youths with 22q11DS were reported to be more socially inhibited and more isolated from peers (Schonherz et al., 2014; Tang et al., 2015). In ASD, difficulties initiating and maintaining social interactions and relationships, as well as a lack of social reciprocity has been described (e.g., Fakhoury, 2015). However, some studies highlighted differences in the phenomenology of these social impairments, for instance more social drive and empathy were reported in youths with 22q11DS compared to idiopathic ASD. In addition, social difficulties in 22q11DS appeared to be more context-dependent than in ASD (Angkustsiri et al., 2014; Kates et al., 2007; McCabe et al., 2013). As loneliness is connected to social relationships by its very definition, it appears important to further investigate loneliness in these clinical populations characterized by social impairments.

Whereas literature on loneliness in the general population has rapidly increased over the years, information remains scarce regarding youths with genetic conditions and neurodevelopmental disorders. Indeed, to the best of our knowledge, there are no studies on loneliness in 22q11DS. In ASD, higher level of loneliness was reported in younger and older adolescents, but also adults (for a review, see Hymas et al., 2022). Moreover, loneliness was found to be associated not only with mental health (i.e., anxiety and depression) (Hymas et al., 2022), but also with autism features in youths with ASD (Schiltz et al., 2021). However, it remains debated whether individuals with ASD like being alone or feel lonely (Deckers et al., 2017), and whether they spend more time alone because they lack interest in being with others or because they experience aversive feelings during interactions (Chevallier et al., 2012). A recent study (Feller et al., 2022) attempted to disentangle these mechanisms using ecological momentary assessment (EMA), a structured diary technique that enables repeated assessments in the flow of daily life (Myin-Germeys et al., 2009). In particular, this study compared the social profiles of youths with ASD and 22q11DS and observed that the two groups reported a preserved motivation for interpersonal interactions, which however seemed to come at a cost since both groups reported a higher desire to be alone when with others. In addition to these similarities, the results also pointed to differences between the groups: individuals with ASD reported more isolation and feelings of being rejected when they were alone, as well as a more negative experience of social interactions than youths with 22q11DS. Although this study provided first insights regarding the experience of social interactions and highlighted similarities but also distinctions between the groups, further explorations are required to better understand the potential impact of the social environment (i.e., social or nonsocial context) on loneliness, as well as the emotional reactivity to loneliness to gain further intel on how affect and loneliness are interrelated.

Also, a distinction has to be made between state and trait loneliness, as most studies measure loneliness as a trait, that is, as a stable, baseline measure (loneliness in general) rather than in response to a specific context (momentary loneliness). But loneliness can also be a temporary state that people experience and that fluctuates over time. It is therefore important to consider these fluctuations, as they may be related to other phenomena such as suicidal thoughts (Kleiman et al., 2017), drinking behavior (Arpin et al., 2015) and depression (Di Blas et al., 2021). According to the differential reactivity hypothesis (Cacioppo et al., 2003), state loneliness depends on trait loneliness because individuals with high trait loneliness respond differently to their environment than those with lower level of trait loneliness. This hypothesis was recently tested in the general population by van Roekel et al. (2018) who combined EMA and questionnaires to assess state and trait loneliness. Indeed,

EMA seems to be a particularly suitable technique for studying state loneliness as it assesses subjective experiences on a daily basis, reflecting in-the-moment feelings, compared to self-reported questionnaires that assess a more stable aspect of loneliness. The authors found a distinct response to state loneliness depending on the high or low trait loneliness of individuals: “high lonely” adolescents experienced higher levels of state loneliness when they were alone compared to “low lonely” adolescents (van Roekel et al., 2018). However, Culbreth et al. (2021) recently focused on the relationship between state and trait loneliness in schizophrenia and found state and trait loneliness to be quite unrelated. Thus, the need to further investigate the association between more stable (attitude toward being alone and trait loneliness) and context-dependent (state loneliness) aspects of loneliness.

## Aims of the study

The current study had three main aims. The first aim was to better characterize daily life loneliness in adolescents and young adults with ASD and 22q11DS with an ecological method allowing access to momentary and situational loneliness (i.e., state loneliness). Three hypotheses were related to this first aim: (1) being alone (i.e., aloneness) and feeling lonely (i.e., loneliness) in daily life was expected to be associated in the three groups (hypothesis 1; EMA); (2) larger within-person fluctuations in loneliness were expected in the clinical groups (hypothesis 2; EMA); (3) differences between the groups were expected in terms of emotional reactivity to loneliness (i.e., higher associated level of NA and lower associated level of PA) (hypothesis 3; EMA). The second aim was to explore a more stable aspect of loneliness (i.e., trait loneliness) as well as the attitude toward aloneness in our clinical populations with the use of classical methods, as well as to explore the potential associations between classical and ecological methods. Two hypotheses are related to this second aim: (1) the attitude toward aloneness (affinity for aloneness and aversion to aloneness), as well as trait loneliness, was compared between the groups. We expected a greater affinity for aloneness as well as a greater aversion to aloneness in participants with ASD and 22q11DS compared to TD, as well as higher trait loneliness in both clinical groups compared to TD (hypothesis 4; questionnaire); (2) the associations between attitude toward aloneness (i.e., questionnaire), trait loneliness (i.e., questionnaire), and state loneliness (i.e., EMA) were examined in the three groups, with the expectation of a positive association between state loneliness and aversion to aloneness and a negative association between state loneliness and affinity for aloneness (hypothesis 5; association between EMA and questionnaire). Our third and last aim was to explore the association between loneliness and mental health with two hypotheses: we expected to find associations between

mental health and loneliness (state, trait, and attitude toward aloneness) (hypothesis 6 and 7; association between EMA and questionnaires) in the clinical groups. Of note, all hypotheses have been co-registered on the OSF platform available at <https://doi.org/10.17605/OSF.IO/3YUHM>.

## METHODS

### Sample

One hundred and sixty-seven participants (79 females, 88 males) aged 12–30 years were included in the study (mean age = 18.77, SD = 4.39). Forty-eight individuals with ASD were recruited in clinical centers, through a network of medical professionals and through announcements to family associations in Switzerland and France. Fifty-four 22q11DS carriers were recruited through the 22q11DS Swiss longitudinal cohort. Sixty-five individuals were in the TD group and were recruited through siblings of 22q11DS carriers and within the Geneva local community. All participants and their caregivers gave their written consent and received a financial compensation of 100 Swiss francs (CHF) for participating in a larger study. Note that the sample of the present study partially overlaps ( $n = 28$  ASD individuals,  $n = 33$  22q11DS individuals,  $n = 46$  TD) with that in a previous study where the complete EMA protocol can be found in supplementary information (Data S1) (Feller et al., 2022). Participants included in the two studies completed the same EMA protocol and only some items of the larger EMA protocol were retained for the present analyses (see Section 2.2.1. for further details).

Inclusion criteria for all participants were to have sufficient command of the French language, and at least one caretaker available to participate to the study. All participants from the ASD group had a confirmed clinical diagnosis of ASD (all participants were assessed with gold-standard instruments for the diagnosis of ASD (ADOS-2 (Lord et al., 2012) and ADI-R (Rutter, Le Couteur, & Lord, 2003)), see Supplementary Table in Data S1 for evaluation scores). All participants in the 22q11DS group had a confirmed genetic diagnosis of microdeletion 22q11.2 (confirmed by micro-array analysis). To consider partial overlap with social impairments classically observed in ASD, they were screened using the social communication questionnaire, a commonly used questionnaire for screening autistic manifestations (SCQ; (Rutter, Bailey, & Lord, 2003)). Both ASD and 22q11DS youths were assessed for comorbid psychiatric disorders using validated semi-structured instruments (clinical scores are reported in Table 1). All the participants were assessed using the Wechsler Intelligence Scales for children or adults (Wechsler, 2011, 2014). Exclusion criteria for TD were (1) premature birth, (2) first-degree relative with developmental disorder (with the exception of a de

TABLE 1 Participant characteristics, psychiatric diagnosis, and medication.

	Group comparisons					
	Diagnostic group			TD-ASD		
	TDs	22q11DS	ASD	Statistical test	p-value	22q11DS-ASD
N	65	54	48			
Gender (female (%))	35 (54%)	22 (41%)	22 (46%)	$\chi^2 = 0.131$	0.134	$\chi^2 = 0.004$
Age (mean (SD))	17.96 (3.82)	19.71 (4.89)	18.17 (4.7)	$F = 1.741$	0.039	$F = -1.538$
Full-scale IQ (mean (SD))	112.66 (12.58)	72.88 (14.43)	105.83 (17.10)	$F = -39.784$	0.000	$F = 32.954$
Period of EMA (%)						
School/Work	34%	26%	34%			
Holidays	62%	67%	62%			
COVID lockdown	4%	7%	4%			
Psychiatric diagnosis (N(%))						
Mood disorders		7 (13%)	15 (31%)			
Anxiety disorders		27 (50%)	17 (35%)			
Social anxiety		9 (17%)	12 (25%)			
Obsessive-compulsive disorder		2 (4%)	3 (6.5%)			
Oppositional defiant disorder		2 (4%)	3 (6.5%)			
Post-traumatic stress disorder		2 (4%)	1 (2%)			
Other		3 (5.5%)	5 (11%)			
Other neurodevelopmental disorders (N(%))						
ADHD		29 (54%)	13 (27%)			
Intellectual disability		24 (44%)	3 (6.25%)			
Medication		32 (60%)	14 (29%)			
Categories		14 (26%)	2 (4%)			
Antidepressants (SSRI)		16 (30%)	7 (15%)			
Mood stabilizers		1 (2%)	0			
Neuroleptics		13 (24%)	6 (12.5%)			
Anxiolytics		3 (5%)	2 (4%)			

Note: TDs had been screened for psychiatric diagnostics conforming to our exclusion criteria. The Diagnostic Interview for Children and Adolescents-Revised (DICA; (Reich, 2000)) or Schedule for Affective Disorders and Schizophrenia for School-Age Children Present and Lifetime Version (K-SADS-PL DSM-5; (Kaufman et al., 2016)) for participants under 18 years old, and the Structured Clinical Interview for DSM-IV Axis I (SCID-I; First, 1997), or DSM-V (SCID-5-CV; Glasofer et al., 2015) for participants above 18 years old. Mood disorders include depressive disorder, dysthymia, bipolar disorder, and severe mood dysregulation. Anxiety disorders include specific phobia, agoraphobia, generalized anxiety, and panic disorder. Other disorders include enuresia, body dysmorphic disorder, trichotillomania, hoarding disorder, and illness anxiety disorder. Participants with an IQ below 70 are reported here in the intellectual disability section. Medication: total = number of participants under medication (some participants take more than one medication). Bold indicates  $p < 0.05$ .

novo 22q11.2 deletion), (3) history of psychiatric, neurological, or learning disorders. Of note, TD was screened using the SCQ and none of them scored above the clinical cutoff. Descriptive characteristics of the sample are displayed in Table 1.

## Materials

### Ecological momentary assessment

Smartphone-based EMA was used to evaluate participants' state loneliness and affects (mean values are displayed in Table 2). The EMA protocol is described in detail in a previous research (Feller et al., 2022). It lasted 6 days with semi-random signal-contingent notifications eight times per day between 7.30 AM and 10 PM, with a minimum time window of 30 min between two consecutive beeps. Only beeps corresponding to a session duration of less than 15 min were retained to ensure that the participants' responses corresponded to the time they were assessed (i.e., in-the-moment assessments). The mean response time was 3.12 min overall (TD  $m = 2.83$  min,  $SD = 4.83$ ; 22q11DS  $m = 3.22$  min,  $SD = 6.06$ ; ASD  $m = 3.42$ ,  $SD = 6.18$ ). Participants with 22q11DS ( $F(2, 4949) = 22.58$ ,  $p = 0.05$ ) and ASD ( $F(2, 4949) = 34.47$ ,  $p = 0.003$ ) spent significantly more time to complete the questionnaire than TD. There was no statistically significant difference between the clinical groups. At each notification, the same momentary EMA

questionnaire was issued. It consisted of a minimum of 33 and a maximum of 38 items, based on responses to conditional branching questions. There were no open-ended questions. Positive affects (PA) (happiness, self-confidence, excitement, relaxation), negative affects (NA) (sadness, anxiety, anger), and state loneliness were assessed using a series of items (see Data S1 for EMA items), rated on a 7-point Likert scale. The principal component analysis showed two distinct components for affects based on loading  $>0.30$ : PA (happy 0.58, excited 0.35, self-confident 0.49, relaxed 0.54) and NA (anxious 0.56, irritated 0.57, sad 0.59). Participants were then asked to indicate whether they were alone (nonsocial context) or in the company of others (social context). Finally, participants were asked about their experience of social interactions and of aloneness (aloneness appreciation, isolation and rejection feelings). Of note, the experience of the social interactions was not examined in the present study given its focus on loneliness. The variables used for the analyses are therefore PA, NA, state loneliness, context, and experience of aloneness (see Data S1 for the complete list of items used to compute these variables, and the co-registration: <https://doi.org/10.17605/OSF.IO/3YUHM>). Consistent with previous studies and general recommendations (Myin-Germeys et al., 2009; Palmier-Claus et al., 2011), only participants who responded to at least one third of the beeps ( $33.3\% = 16$  beeps) were retained in the analyses. A total of 10 participants were excluded from the analyses for this reason ( $n = 5$  individuals with ASD,  $n = 2$  individuals with 22q11DS,

**TABLE 2** Descriptive statistics of variables of interests (means (SD)).

	Diagnostic group		
	TDs	22q11DS	ASD
Questionnaires			
LLCA affinity	27.38 (5.76)	28.16 (8.37)	36.27 (8.71)
LLCA aversion	28 (6.71)	23.96 (6.91)	23.11 (8.13)
LLCA parents	17.90 (6.10)	18.6 (6.25)	21 (6.44)
LLCA peers	19.05 (6.79)	19.04 (6.99)	26.27 (8.03)
ASR/YSR total	49.85 (8.67)	56.92 (11.70)	63.91 (10.62)
ASR/YSR internalized symptoms	50.29 (9.65)	59.76 (12.23)	68.46 (11.22)
ASR/YSR externalized symptoms	51.57 (9.07)	52.55 (10.36)	54.86 (10.27)
ABCL/CBCL total	35.67 (17.28)	66.4 (19.84)	75.76 (21.15)
ABCL/CBCL internalized symptoms	51.41 (7.95)	59.5 (8.63)	63.02 (10.58)
ABCL/CBCL externalized symptoms	45.57 (10.14)	54.76 (8.93)	59.21 (10.02)
EMA items			
Positive affects	3.92 (0.71)	4.09 (1.02)	3.69 (0.92)
Negative affects	1.49 (0.42)	1.65 (0.99)	1.99 (0.89)
State loneliness	1.62 (1.23)	1.48 (1.14)	1.53 (1.09)
Isolation feeling	1.2 (0.52)	1.3 (0.93)	1.66 (1.58)
Appreciation of aloneness	3.55 (1.93)	4.65 (1.78)	5.66 (1.29)
Percentage of time spent alone	36.74 (22.32)	39.85 (26.64)	38.62 (23.40)

Note: For ASR, YSR, CBCL, and ABCL *T*-scores are reported.

$n = 3$  TD). The final sample used for the analyses therefore consisted of 157 individuals ( $n = 43$  ASD individuals with 1449 valid notifications,  $n = 52$  22q11DS individuals with 1548 valid notifications,  $n = 62$  TD with 2053 valid notifications).

## Questionnaires

All the participants completed the Loneliness and Aloneness Scale for children and adolescents (LACA; (Danneel, Maes, Bijttebier, et al., 2018)), a self-reported questionnaire with 48 statements answered on a 4-point Likert scale (never, rarely, sometimes, often) that measures trait loneliness and attitude toward being alone with four subscales: aversion to aloneness (with higher scores indicating a negative attitude toward aloneness), affinity for aloneness (with higher scores indicating a positive attitude toward aloneness), and loneliness toward peers and loneliness toward parents (with higher scores indicating higher loneliness). Note that the subscale “loneliness toward peers” was used as a measure of trait loneliness, as it was found to correlate strongly with classical measure of loneliness such as the UCLA Loneliness Scale (Goossens et al., 2009). Mean values are displayed in Table 2.

General psychopathology dimensions were assessed by participants themselves, using the youth or adult self-reported questionnaire (YSR/ASR), as well as by their caregivers, using the child or adult behavior checklist (CBCL/ABCL) (Achenbach & Rescorla, 2001, 2003). These paper-pencil questionnaires assess different aspects of psychopathology using items answered on a Likert scale from 0 to 2 that are grouped into syndrome scales of internalizing behaviors (composed of anxious/depressed, withdrawn and somatic complaints subscales) and externalizing behaviors (composed of attention problems, aggressive behavior, rule-breaking behavior, and intrusiveness subscales) (Achenbach & Rescorla, 2001, 2003). The age-normalized *T-scores* of total psychopathology and internalizing and externalizing subscales were used in the analyses, with higher scores indicating greater mental health difficulties. The test-retest reliabilities for these three subscales range from 0.80 to 0.94, and Cronbach's alpha coefficients from 0.90 to 0.97 (Achenbach & Rescorla, 2001, 2003).

Of note, scores on the CBCL psychopathology scales were shown to be highly correlated with the result of a clinical assessment (e.g., Warnick et al., 2008). High test-retest reliability (0.89) was also reported for the syndrome scales in a study assessing children with ASD (e.g., Mazefsky et al., 2011). The ASR was also previously used to assess psychopathology in adults with ASD (e.g., Gadke et al., 2016). Mean values are displayed in Table 2.

## Statistical analysis

This study was co-registered on the OSF platform during data collection (<https://doi.org/10.17605/OSF.IO/3YUHM>) and the data set is publicly available through the YARETA data preservation system. Additional information regarding the specific statistical models used to test each hypothesis can be found in the registration document. Statistical analyses were conducted in STATA version 16.1 (StataCorp, 2019). For all analyses, the level of statistical significance was set to  $p < 0.05$ . Benjamini-Hochberg (BH) multiple comparison correction was applied for correlations. Analyses of variance (ANOVA) and chi-squared tests were used to investigate group differences in age, gender and IQ.

The EMA data have a two-level structure with repeated measurements (level 1) nested within individuals (level 2). Multiple linear regression models were performed for group comparisons for time-invariant variables (i.e., one observation per participant), using the REGRESS command. Multilevel regression analyses with random intercepts were performed to compute group differences in time-varying variables (i.e., one observation per beep for participant), using the XT MIXED command. The *B*'s represent the fixed regression coefficients of the predictors in the multilevel model. Age, gender, and EMA period (holidays; school/work; lockdown due to covid-19) were included as covariates in the models. Of note, IQ was not used as a covariate since lower IQ is part of the phenotype of many neurodevelopmental disorders. Therefore, covarying for IQ would remove some of the variance inherent to the diagnosis (Dennis et al., 2009). The percentage of time spent alone was added as a covariate in the model testing the association between state loneliness and mental health (hypothesis 6), which represents a deviation from the original statistical plan. We also performed additional analyses that represent another deviation from the original statistical plan by including a measure of trait loneliness in our analyses (hypotheses 4, 5, 6, and 7). Note that for hypothesis 7, post-hoc analyses were conducted on internalizing and externalizing subscales only when the association with the total psychopathology score was significant. For the analyses including EMA data, data from all the beeps were used to examine state loneliness according to the social context (hypothesis 1) and the association between loneliness and mental health (hypothesis 6), whereas only the beeps in the nonsocial context were considered for remaining hypotheses. For the variability analysis (hypothesis 2), a likelihood ratio test was performed to compare a model in which the error variance of loneliness was allowed to differ between groups (i.e., within-person variability in the measurement of loneliness over time) with a model where the error variance of loneliness was assumed to be equal. Of note, all the other analyses were conducted at the between-person level.

## RESULTS

### Sample characteristics

The three groups were not statistically different in terms of gender. Participants with 22q11DS were significantly older than TD participants. There was no other difference in terms of age between the groups. To account for the potential impact of age on our results, we separated our groups into adolescents (<18 years old) and adults (>18 years old) and found no statistically significant difference between younger and older youths on state and trait loneliness, as well as on attitude toward being alone (see Data S1). Both participants with ASD and TD differed from 22q11DS on full-scale IQ scores. This was expected, given that impaired cognitive functioning is a core characteristic of individuals with 22q11DS. The average IQ level in the 22q11DS group was 73, which corresponds to what is typically reported in this population (e.g., Vorstman et al., 2015). The average IQ level in the ASD group was 106, with only three participants having an IQ in the intellectual disability range (IQ <70). Participants with ASD also differed from TD participants on IQ level. This difference may be explained by the relatively high average IQ of the TD participants. Mean values and group comparisons are displayed in Table 1. Of note, 14 participants with 22q11DS scored above the clinical cutoff on the SCQ. To investigate the impact of participants with an elevated SCQ score on the obtained results, all the analyses were conducted while excluding these 14 participants and the results remained unchanged (data not shown). The results reported below therefore include the entire 22q11DS sample.

### Loneliness in daily life

There was no difference between the groups in terms of state loneliness (all  $p > 0.05$ ). Overall, all participants reported feeling more lonely when they were alone than when they were in company of others ( $b = 0.487$  (95% CI 0.273 to 0.699),  $p < 0.001$ ). The group  $\times$  context interaction was not significant (all  $p > 0.05$ ), indicating that the association between loneliness and being alone or in company of others was similar in the three groups.

At a within-person level, the model allowing error variance to differ fitted significantly better than the model with a fixed error variance ( $X^2(2) = 24.65$ ,  $p < 0.001$ ). Post-hoc analysis showed that individuals with ASD showed larger within-person fluctuations in loneliness ( $\text{var}(e) = 1.35$ ,  $SD = 0.08$ ) compared to participants with 22q11DS ( $\text{var}(e) = 1.124$ ,  $SD = 0.07$ ) as well as TD ( $\text{var}(e) = 0.89$ ,  $SD = 0.04$ ) (ASD-22q11DS: ( $X^2(1) = 4.32$ ,  $p = 0.037$ ); ASD-TD: ( $X^2(1) = 24.5$ ,

$p < 0.001$ )). A significantly larger variance was also observed in participants with 22q11DS compared to TD ( $X^2(1) = 7.8$ ,  $p = 0.005$ ).

### Emotional reactivity in response to loneliness

Overall, all participants reported higher levels of NA in association with greater loneliness ( $b = 0.393$  (95% CI 0.329–0.458),  $p < 0.001$ ). The loneliness  $\times$  group interaction was significant between ASD and 22q11DS participants only ( $b = 0.153$  (95% CI 0.048–0.258),  $p = 0.004$ ), indicating a stronger affective reactivity to loneliness in participants with ASD compared to 22q11DS.

Overall, all participants reported lower levels of PA in association with greater loneliness ( $b = -0.171$  (95% CI -0.249 to -0.093),  $p < 0.001$ ). The loneliness  $\times$  group interaction was significant between 22q11DS participants and both ASD ( $b = -0.185$  (95% CI -0.301 to -0.075),  $p < 0.001$ ) and TD participants ( $b = 0.151$  (95% CI 0.036–0.264),  $p = 0.01$ ), meaning that the negative association between loneliness and PA was stronger in ASD and TD participants compared to 22q11DS. There was no difference between TD and ASD participants. Post-hoc analysis showed that loneliness was associated with a lower associated level of PA in TD ( $b = -0.178$  (95% CI -0.254 to -0.101),  $p < 0.001$ ) and ASD ( $b = -0.199$  (95% CI -0.274 to -0.123),  $p < 0.001$ ), but not in 22q11DS ( $b = -0.008$  (95% CI -0.097 to 0.080),  $p = 0.848$ ).

### Attitude toward being alone and loneliness toward parents and peers

Both individuals with 22q11DS ( $b = 8.307$  (95% CI 1.63–14.97),  $p = 0.017$ ) and ASD ( $b = 12.64$  (95% CI 5.38–19.91),  $p = 0.002$ ) expressed a higher affinity toward being alone than TD. The two clinical groups did not differ from each other ( $p > 0.05$ ).

Individuals with ASD expressed a lower aversion toward being alone than TD ( $b = 9.76$  (95% CI -16.34 to -3.20),  $p = 0.005$ ). There was no other statistically significant difference (all  $p > 0.05$ ).

Individuals with ASD reported more loneliness toward peers (i.e., trait loneliness) than both TD ( $b = 7.65$  (95% CI 3.10–12.18),  $p = 0.001$ ) and 22q11DS ( $b = 8.045$  (95% CI 3.61–12.48),  $p = 0.001$ ) participants. Individuals with 22q11DS did not differ from TD ( $p > 0.05$ ).

There was no significant group difference on loneliness toward parents (all  $p > 0.05$ ). As participants did not differ on this subscale and as it was not the focus on the present study, we did not keep this subscale for further analyses.

## Association between attitude toward being alone, trait loneliness (i.e., loneliness toward peers), and daily life loneliness

State loneliness was not associated with either affinity or aversion toward being alone in any of the groups (all  $p > 0.05$ ), nor with trait loneliness (all  $p > 0.05$ ). Experience of aloneness (appreciation and rejection-isolation feeling) in daily life was not associated with attitude toward being alone in any of the groups either (all  $p > 0.05$ ), nor with trait loneliness (all  $p > 0.05$ ).

## Association between attitude toward being alone, trait loneliness (i.e., loneliness toward peers), daily life loneliness, and mental health

In youths with 22q11DS, self-reported mental health (total score) was associated with state loneliness ( $b = 0.027$  (95% CI 0.010–0.045),  $p = 0.002$ ), trait loneliness ( $b = 0.465$  (95% CI 0.185–0.744),  $p = 0.002$ ), and affinity for aloneness ( $b = 0.486$  (95% CI 0.119–0.852),  $p = 0.012$ ). These associations survived BH correction for multiple associations. Aversion to aloneness was also associated with self-reported mental health but did not survive BH correction. Associations with internalizing and externalizing symptoms are reported in (Data S1). There was no statistically significant association with parent-reported mental health (all  $p > 0.05$ ).

In youths with ASD, self-reported mental health (total score) was associated with affinity for aloneness ( $b = 0.502$  (95% CI 0.134–0.871),  $p = 0.011$ ) that survived BH correction for multiple association. Associations with internalizing and externalizing symptoms are reported in (Data S1). There was no other statistically significant association (all  $p > 0.05$ ). Loneliness was not statistically associated with parent-reported mental health (all  $p > 0.05$ ).

## DISCUSSION

The objective of this study was to better characterize loneliness (trait, state, and attitude toward aloneness) in two neurodevelopmental disorders, as well as its link with emotional reactivity and mental health. Our main findings indicate that there was no difference between the groups on state loneliness in daily life, and all participants reported feeling more lonely when they were alone than when in the company of others. However, the variance of loneliness was significantly different between groups, with larger within-person fluctuations in loneliness in participants with ASD compared to 22q11DS and TD, as well as in participants with 22q11DS compared to TD. Regarding attitude toward being alone, both participants with 22q11DS and ASD expressed greater affinity toward being alone than TD, and participants with ASD

expressed lower aversion toward being alone than TD. Participants with ASD expressed higher trait loneliness than both TD and 22q11DS, who did not differ from each other. However, state loneliness as well as the subjective experience of aloneness in daily life was not associated with affinity or aversion toward being alone in any of the three groups, nor with trait loneliness. In terms of emotional reactivity to loneliness, there was a higher associated level of NA in participants with ASD compared to 22q11DS, as well as a lower associated level of PA in ASD and TD participants compared to 22q11DS. Finally, in both clinical populations, associations between loneliness and mental health were only significant with self-reported but not with parent-reported scores.

## Attitude toward aloneness, trait, and state loneliness

The intensity of daily life loneliness (i.e., state loneliness) was similar across the groups, contrary to several studies in ASD highlighting higher levels of loneliness in youths with ASD (Grace et al., 2022; Lasgaard et al., 2010; Sundberg, 2018). However, others studies also reported no difference in loneliness between TD and ASD (Bottema-Beutel et al., 2019; Chamberlain et al., 2007). In line with these mixed results, the question of the definition of loneliness should be considered, that is the distinction between being alone and feeling lonely. For instance, Bauminger and Kasari (2000) found that children with ASD defined loneliness in terms of being physically alone, whereas the emotional component of feeling lonely was present in TD children only. In the present study, all participants reported feeling lonelier when they were alone than when in the company of others. This indicates a broader understanding of the definition of loneliness, including the potential resource of others as a way out of loneliness. This finding is consistent with our previous study on daily life social interactions, which found a similar desire to be with others when alone in individuals with neurodevelopmental disorders compared to TD, pointing toward a preserved motivation for interpersonal interactions (Feller et al., 2022). Additionally, a recent study highlighted the complex role of state loneliness, being both a predictor and a consequence of social interaction, in the regulation of social affiliation (Reissmann et al., 2021). To further explore loneliness, it seemed important to consider its potential variation to unmask intra-individual variability that disappears when conducting between group comparisons. At a within-person level, results showed larger variability in loneliness among individuals with neurodevelopmental disorders than among TD, and even larger variability among individuals with ASD than among 22q11DS carriers. So even if there was no difference in the overall feeling of loneliness, there was more variation within individuals of the

clinical groups, especially ASD, pointing toward a distinction in the fluctuation of loneliness over time, with more intense peaks in the clinical groups. This may be due to the higher prevalence of mental health symptoms in individuals with ASD (Hossain et al., 2020) and 22q11DS (Schneider et al., 2014), as it has been shown that depressed individuals exhibit more within-person fluctuations of loneliness (Di Blas et al., 2021).

On the opposite, differences were observed between the groups in the way individuals considered their attitude toward aloneness. The present results pointed that the clinical groups expressed greater affinity toward being alone. Youths with ASD also reported higher level of trait loneliness (i.e., peer-related loneliness) than youths with 22q11DS and TD. As Jones and Hebb (2003) found an association between trait loneliness and objective aspects of a person's social network (smaller social networks, lack of intimate relationships), it is not surprising to observe greater affinity toward being alone in clinical groups that have a different involvement in the social sphere, with less contact with peers and more with their family (Feller et al., 2022). Interestingly, a recent study identified several groups of adolescents based on their profile of loneliness, with a group reporting positive attitude toward aloneness but peer-related loneliness, that was correlated with low adaptive functioning in peer groups and friendships (Maes et al., 2016). In line with this, our results showed that only youths with ASD reported higher trait loneliness, pointing toward a distinction in the social profiles of youths with 22q11DS and ASD. Further studies are needed to explore this difference in more depth, notably the correlation with social adaptive functioning that we did not investigate in the present study. Moreover, having a more positive attitude toward being alone could also come from the challenging social interactions experienced by individuals with neurodevelopmental disorders who endure more victimization and bullying (DePape & Lindsay, 2016; Sterzing et al., 2012). In TD samples, such negatives experiences were indeed found to be associated with greater affinity toward being alone (Corsano et al., 2006).

However, enjoying being alone per se is also a quality and has benefits (Long & Averill, 2003), indicating that one considers oneself essential to one's well-being. Humans are often considered to be social creatures, de facto excluding those who value solitude and are considered unsociable (Daly & Willoughby, 2020). However, the tendency to pathologize aloneness has been debated for some time (e.g., Buchholz & Chinlund, 1994). Indeed, positive attitudes toward aloneness tend to emerge during adolescence, as time spent alone can be used to emotional self-regulation and identity development (Long & Averill, 2003). Therefore, it is only when the time spent alone is excessive that there can be a shift in the attitude toward aloneness, which can become negative and then lead to loneliness (Maes et al., 2016). In the present study, we found that individuals with ASD reported lower aversion

toward being alone, confirming that being alone is not necessarily aversive and that positive and negative attitudes toward aloneness should not be considered as two opposite ends of the same continuum (Maes et al., 2015). Moreover, "social respite", or the need to reboot after social interactions, is commonly reported in youths with ASD, since social interactions are described as costing a lot of energy and restorative time alone is thus needed after spending time with others (e.g., Elmore, 2020). This idea is also in line with the hypothesis of the "cost of interaction" that we previously developed in a previous study (Feller et al., 2022). The lower aversion toward being alone could therefore be interpreted as a result of this need for "social respite."

But does considering yourself a lone wolf really make you a lone wolf in everyday life? Interestingly, no association was found between attitude toward aloneness, trait and state loneliness in the present study. Culbreth et al. (2021) also reported this lack of association in schizophrenia. Strikingly, the appreciation of aloneness, as measured by the EMA items "I like being alone" and "I feel excluded, rejected", was not associated with attitude toward aloneness. This highlights a discrepancy between how people perceive themselves in general and how they actually react in-the-moment. However, in the general population, Mote et al. (2020) found associations between momentary and dispositional loneliness. A correspondence between the two types of loneliness was also found by van Roekel et al. (2018) who observed different patterns of loneliness appreciation depending on levels of trait loneliness. Further research is therefore needed to fully examine the associations between attitude toward aloneness, state and trait loneliness.

## Emotional reactivity to loneliness

Different patterns of emotional reactivity to loneliness were observed in the groups. On the one hand, participants with 22q11DS only reported a higher associated level of NAs but no change in PAs, which raises the question of fine-grained emotion identification in 22q11DS population which is known for impairments in emotion recognition (Norkett et al., 2017). Moreover, negative symptoms of psychosis are frequent and can be severe in the context of 22q11DS (Schneider et al., 2012). Therefore, the lack of change in PAs in reaction to loneliness in 22q11DS could be linked with negative symptoms, such as emotional blunting. On the other hand, participants with ASD seemed particularly emotionally reactive to loneliness. This result could stem from prior negative stressful interactions that led to loneliness. Indeed, several studies conducted in the general population pointed toward a link between loneliness and bullying: being victimized increase loneliness (Graham et al., 2006), and it was shown that both victims of bullying and bullies reported feeling more lonely later in life

(Ireland & Power, 2004). A circular interaction between bullying and loneliness has also been suggested (Kochenderfer-Ladd & Wardrop, 2001). As higher rates of victimization and bullying were reported among youths with ASD (DePape & Lindsay, 2016; Sterzing et al., 2012), the association with loneliness may be an interesting avenue to pursue in future studies. Moreover, higher daily life perceived stress, including social stress, was reported in youths with ASD in a sample partially overlapping the one of the present study (Ilen et al., 2022). These negative experiences could then lead to feeling more lonely and increase the negative appraisal of loneliness in general (van Roekel et al., 2015, 2019). The emotional reactivity to loneliness could also be explained by difficulties in emotion processing that are well documented in ASD (Chaidi & Drigas, 2020; Nuske et al., 2013). For example, poor emotion regulation (ER) was associated with socioemotional and behavioral difficulties in ASD (Mazefsky et al., 2013). Interestingly, Kearns and Creaven (2017) reported lower levels of loneliness in individuals employing adaptive styles (e.g., positive reappraisal) in response to negative emotions, whereas higher levels of loneliness were found in individuals using maladaptive styles (e.g., rumination). Therefore, ER might play a role in individuals' response to loneliness. Many individuals with neurodevelopmental disorders face challenges in it (England-Mason, 2020; Samson et al., 2015): in 22q11DS, youths were reported to use significantly less adaptive ER strategies (Ilen et al., 2023), the latter being associated with the overall severity of the psychopathology (Campbell et al., 2022). In ASD, youths appeared more likely to use less adaptive and more nonadaptive ER strategies, leading to an increase of their affective response to daily stress (Ilen et al., 2022). Further research could focus on the association between ER and emotional reactivity to better understand the link with loneliness.

## Loneliness and mental health

Loneliness has been described as a predictor of mental health difficulties (Elmer et al., 2020; Hedley et al., 2018; Hymas et al., 2022). Moreover, experiencing loneliness was reported to predict greater psychological distress immediately (moment-to-moment level), but also across days (day-to-day level) (Yung et al., 2021). Taken together, these studies show that it is important to be particularly vigilant about individuals who report feeling lonely. And indeed, the findings of the present study pointed toward an association between loneliness and mental health. Because loneliness has never been studied in 22q11DS, the association between mental health and both state and trait loneliness, as well as attitude toward being alone is an important addition to the existing literature. But our results also pointed toward an association with self-reported measures only. Therefore, the lack of

association with questionnaires completed by caregivers shows the importance of assessing symptoms with young people directly and not relying solely on the assessment of relatives, as their perception of the various difficulties may differ. Notably, a recent study measuring executive functioning in ASD revealed a moderate correspondence between executive functioning reported by youths themselves and reported by their parents, highlighting that their views are related but not identical (Kenworthy et al., 2022). Other studies highlight the need for a combination of self- and parent-reports to screen for psychiatric comorbidities in ASD (Mazefsky et al., 2011; Renk & Phares, 2004).

## Strengths, limitations, and future directions

This study investigated two populations with social difficulties that may lead to loneliness, investigating both trait and state loneliness, as well as attitude toward aloneness. Combining the contextual and dispositional aspects of loneliness provided comprehensive information to build a complete picture on loneliness and reinforces the need to combine classical and ecological methods to fully understand a phenomenon as complex as loneliness. Moreover, to our knowledge, this is the first time that such a study has been conducted in 22q11DS, thus reinforcing the need to consider loneliness in the clinical care of these patients.

However, the results of this study must be considered with some methodological limitations. First, EMA is a method that relies on the participants' self-evaluation, requiring a certain level of introspection. A limitation could thus be found in their understanding of the questions, which is why particular care was taken to explain the protocol when installing the application. Moreover, this method has been validated in typically and atypically developing youths (Russell & Gajos, 2020), as well as in individuals with mild intellectual disability (Wilson et al., 2020). Second, it is important to know that the participants in this study represent only a part of the autism spectrum but also of 22q11DS. Indeed, individuals with severe cognitive impairments could not be included in the present study since the methodology used required reading and understanding the questions but also being able to engage in introspection. Therefore, the results cannot be generalized to all individuals with ASD or 22q11DS. Finally, the wide age range of our sample could be seen as a limitation, as young adolescents and young adults might respond differently, given the different developmental changes and social environments they experience. All the analyses were conducted with age as a covariate, as well as by separating participants by age (<18 and >18 years old). There was no statistically significant difference between younger and older participants in state and trait loneliness, as well as in attitude toward being alone. Similarly, research in the general population has

shown that levels of loneliness remain relatively stable from adolescence to adulthood (e.g., Mund et al., 2020). In ASD, a recent study reported an increase in loneliness from early adolescence to adulthood, but used a distinct methodology without distinguishing state and trait loneliness, or attitude toward being alone (Schiltz et al., 2023). Moreover, our design was cross-sectional and not longitudinal. Future studies with a longitudinal design are therefore needed to investigate state and trait loneliness, as well as attitude toward being alone, in greater detail within each group.

## Conclusions

The present study highlighted different profiles of loneliness between two populations known to have social difficulties. Indeed, whereas both the general and clinical populations reported a greater sense of loneliness when they were actually alone, individuals with ASD were particularly emotionally reactive to loneliness. This highlights the need of tailored interventions that address population-specific challenges. Another key finding was the greater affinity for being alone that we found in both clinical groups, emphasizing the positive aspect of enjoying one's own company but also underlying the cost of social interactions for people known for having difficulties in the social sphere. However, only youths with ASD reported higher levels of trait loneliness, highlighting a distinction in the social profiles across the two clinical groups. Finally, the fact that only self-rated mental health was associated with loneliness underscored the need to include participant's and not only caregivers' appraisal in assessing mental health, even in clinical populations that may be considered more vulnerable and less effective at self-assessment. This opens new reflections on the clinical care of these individuals which must be adapted to their clinical—but also individual—profiles. The two take home messages for clinical care are that there is a need to remain vigilant when encountering youths who report feeling lonely, and that youths with ASD and 22q11DS need help to expand and rely on their social network, as it appeared that being with others is a protective factor against loneliness.

## AUTHOR CONTRIBUTIONS

CF and MS designed the study. CF and LI were involved in data collection. MS contributed to the statistical analyses. CF conducted the statistical analyses and wrote the first draft of the manuscript. MS provided critical revisions. All the co-authors commented on the manuscript and approved its submission.

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## CONFLICT OF INTEREST STATEMENT

The author declares that they have no conflict of interest to disclose.

## DATA AVAILABILITY STATEMENT

This study was co-registered on the OSF platform (10.17605/OSF.IO/3YUHM) and the data set is publicly available through the YARETA data preservation system (10.26037/yareta:pymdasrt3ng6jde5eje36rmwum).

## ETHICS STATEMENT

This study was approved by the Swiss Ethics Committees on research involving humans (Commission Cantonale d'Ethique de la Recherche sur l'être humain—CCER) of Geneva (CH).

## ORCID

Clémence Feller  <https://orcid.org/0000-0002-4414-1257>

Laura Ilen  <https://orcid.org/0000-0003-1650-5874>

## REFERENCES

- Achenbach, T. M., & Rescorla, L. A. (2001). *Manual for the ASEBA school-age forms and profiles*. University of Vermont, Research Center for Children, Youth and Families.
- Achenbach, T. M., & Rescorla, L. A. (2003). *Manual for the ASEBA adult forms and profiles*. University of Vermont, Research Center for Children, Youth and Families.
- Angkustsiri, K., Goodlin-Jones, B., Deprey, L., Brahmabhatt, K., Harris, S., & Simon, T. J. (2014). Social impairments in chromosome 22q11.2 deletion syndrome (22q11.2DS): Autism spectrum disorder or a different endophenotype? *Journal of Autism and Developmental Disorders*, 44(4), 739–746. <https://doi.org/10.1007/s10803-013-1920-x>
- Arpin, S. N., Mohr, C. D., & Brannan, D. (2015). Having friends and feeling lonely: A daily process examination of transient loneliness, socialization, and drinking behavior. *Personality and Social Psychology Bulletin*, 41(5), 615–628. <https://doi.org/10.1177/0146167215569722>
- Bauminger, N., & Kasari, C. (2000). Loneliness and friendship in high-functioning children with autism. *Child Development*, 71(2), 447–456. <https://doi.org/10.1111/1467-8624.00156>

- Blagojevic, C., Heung, T., Theriault, M., Tomita-Mitchell, A., Chakraborty, P., Kernohan, K., Bulman, D. E., & Bassett, A. S. (2021). Estimate of the contemporary live-birth prevalence of recurrent 22q11.2 deletions: A cross-sectional analysis from population-based newborn screening. *CMAJ Open*, 9(3), E802–E809. <https://doi.org/10.9778/cmajo.20200294>
- Bottema-Beutel, K., Kim, S. Y., & Crowley, S. (2019). A systematic review and meta-regression analysis of social functioning correlates in autism and typical development. *Autism Research*, 12(2), 152–175. <https://doi.org/10.1002/aur.2055>
- Buchholz, E. S., & Chinlund, C. (1994). En route to a harmony of being: Viewing aloneness as a need in development and child analytic work. *Psychoanalytic Psychology*, 11(3), 357–374. <https://doi.org/10.1037/h0079555>
- Cacioppo, J. T., Hawkley, L. C., & Berntson, G. G. (2003). The anatomy of loneliness. *Current Directions in Psychological Science*, 12(3), 71–74. <https://doi.org/10.1111/1467-8721.01232>
- Campbell, L. E., Swaab, L., Freeman, E. E., McCormack, L., Simon, T. J., Angkustsiri, K., & McCabe, K. L. (2022). The importance of understanding individual differences of emotion regulation abilities in 22q11.2 deletion syndrome. *Journal of Autism and Developmental Disorders*, 52(7), 3076–3087. <https://doi.org/10.1007/s10803-021-05172-9>
- Chaidi, I., & Drigas, A. (2020). Autism, expression, and understanding of emotions: Literature review. *International Journal of Online and Biomedical Engineering*, 16(2), 94–111. <https://doi.org/10.3991/ijoe.v16i02.11991>
- Chamberlain, B., Kasari, C., & Rotheram-Fuller, E. (2007). Involvement or isolation? The social networks of children with autism in regular classrooms. *Journal of Autism and Developmental Disorders*, 37(2), 230–242. <https://doi.org/10.1007/s10803-006-0164-4>
- Chevallier, C., Kohls, G., Troiani, V., Brodtkin, E. S., & Schultz, R. T. (2012). The social motivation theory of autism. *Trends in Cognitive Sciences*, 16(4), 231–239. <https://doi.org/10.1016/j.tics.2012.02.007>
- Corsano, P., Majorano, M., & Champretavy, L. (2006). Psychological well-being in adolescence: The contribution of interpersonal relations and experience of being alone. *Adolescence*, 41(162), 341–353.
- Culbreth, A. J., Barch, D. M., & Moran, E. K. (2021). An ecological examination of loneliness and social functioning in people with schizophrenia. *Journal of Abnormal Psychology*, 130(8), 899–908. <https://doi.org/10.1037/abn0000706>
- Daly, O., & Willoughby, T. (2020). A longitudinal person-centered examination of affinity for aloneness among children and adolescents. *Child Development*, 91(6), 2001–2018. <https://doi.org/10.1111/cdev.13411>
- Danneel, S., Maes, M., Bijttebier, P., Rotsaert, M., Delhay, M., Berenbaum, T., & Goossens, L. (2018). Loneliness and attitudes toward aloneness in Belgian adolescents: Measurement invariance across language, age, and gender groups. *Journal of Psychopathology and Behavioral Assessment*, 40(4), 678–690. <https://doi.org/10.1007/s10862-018-9671-9>
- Danneel, S., Maes, M., Vanhalst, J., Bijttebier, P., & Goossens, L. (2018). Developmental change in loneliness and attitudes toward aloneness in adolescence. *Journal of Youth and Adolescence*, 47(1), 148–161. <https://doi.org/10.1007/s10964-017-0685-5>
- Deckers, A., Muris, P., & Roelofs, J. (2017). Being on your own or feeling lonely? Loneliness and other social variables in youths with autism Spectrum disorders. *Child Psychiatry and Human Development*, 48(5), 828–839. <https://doi.org/10.1007/s10578-016-0707-7>
- Dennis, M., Francis, D. J., Cirino, P. T., Schachar, R., Barnes, M. A., & Fletcher, J. M. J. M. (2009). Why IQ is not a covariate in cognitive studies of neurodevelopmental disorders. *Journal of the International Neuropsychological Society*, 15(3), 331–343. <https://doi.org/10.1017/S1355617709090481>
- DePape, A. M., & Lindsay, S. (2016). Lived experiences from the perspective of individuals with autism Spectrum disorder: A qualitative meta-synthesis. *Focus on Autism and Other Developmental Disabilities*, 31(1), 60–71. <https://doi.org/10.1177/1088357615587504>
- Di Blas, L., Borella, M., & Ferrante, D. (2021). Short-term effects of fluctuations in self-esteem, perceived stress and loneliness on depressive states. *Psihologijske Teme*, 30(1), 99–114. <https://doi.org/10.31820/pt.30.1.5>
- Elmer, T., Geschwind, N., Peeters, F., Wichers, M., & Bringmann, L. (2020). Getting stuck in social isolation: Solitude inertia and depressive symptoms. *Journal of Abnormal Psychology*, 129(7), 713–723. <https://doi.org/10.1037/abn0000588>
- Elmose, M. (2020). Understanding loneliness and social relationships in autism: The reflections of autistic adults. *Nordic Psychology*, 72(1), 3–22. <https://doi.org/10.1080/19012276.2019.1625068>
- England-Mason, G. (2020). Emotion regulation as a Transdiagnostic feature in children with neurodevelopmental disorders. *Current Developmental Disorders Reports*, 7(3), 130–138. <https://doi.org/10.1007/s40474-020-00200-2>
- Fakhoury, M. (2015). Autistic spectrum disorders: A review of clinical features, theories and diagnosis. *International Journal of Developmental Neuroscience*, 43, 70–77. <https://doi.org/10.1016/j.ijdevneu.2015.04.003>
- Feller, C., Ilen, L., Eliez, S., & Schneider, M. (2022). Characterizing daily-life social interactions in adolescents and Young adults with neurodevelopmental disorders: A comparison between individuals with autism Spectrum disorders and 22q11.2 deletion syndrome. *Journal of Autism and Developmental Disorders*, 53, 245–262. <https://doi.org/10.1007/s10803-021-05423-9>
- First, M. B. (1997). *Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I), Clinician Version (Administration Booklet)*. American Psychiatric Publishing, Inc.
- Gadke, D. L., McKinney, C., & Oliveros, A. (2016). Autism Spectrum disorder symptoms and comorbidity in emerging adults. *Child Psychiatry and Human Development*, 47(2), 194–201. <https://doi.org/10.1007/s10578-015-0556-9>
- Glaser, Deborah R., Amanda J. Brown, and Melissa Riegel. (2015). Structured clinical interview for DSM-IV (SCID). *Encyclopedia of feeding and eating disorders*, 1–4
- Goossens, L., Lasgaard, M., Luyckx, K., Vanhalst, J., Mathias, S., & Masy, E. (2009). Loneliness and solitude in adolescence: A confirmatory factor analysis of alternative models. *Personality and Individual Differences*, 47(8), 890–894. <https://doi.org/10.1016/j.paid.2009.07.011>
- Grace, K., Remington, A., Lloyd-Evans, B., Davies, J., & Crane, L. (2022). Loneliness in autistic adults: A systematic review. *Autism*, 26(8), 2117–2135. <https://doi.org/10.1177/13623613221077721>
- Graham, S., Bellmore, A. D., & Mize, J. (2006). Peer victimization, aggression, and their Co-occurrence in middle school: Pathways to adjustment problems. *Journal of Abnormal Child Psychology*, 34(3), 363–378. <https://doi.org/10.1007/s10802-006-9030-2>
- Hedley, D., Uljarević, M., Wilmot, M., Richdale, A., & Dissanayake, C. (2018). Understanding depression and thoughts of self-harm in autism: A potential mechanism involving loneliness. *Research in Autism Spectrum Disorders*, 46(2017), 1–7. <https://doi.org/10.1016/j.rasd.2017.11.003>
- Hossain, M. M., Khan, N., Sultana, A., Ma, P., McKyer, E. L. J., Ahmed, H. U., & Purohit, N. (2020). Prevalence of comorbid psychiatric disorders among people with autism spectrum disorder: An umbrella review of systematic reviews and meta-analyses. *Psychiatry Research*, 287, 112922. <https://doi.org/10.1016/j.psychres.2020.112922>
- Hymas, R., Badcock, J. C., & Milne, E. (2022). Loneliness in autism and its association with anxiety and depression: A systematic review with meta-analyses. *Review Journal of Autism and Developmental Disorders*, 1–36, 121–156. <https://doi.org/10.1007/s40489-022-00330-w>
- Ilen, L., Feller, C., Eliez, S., & Schneider, M. (2023). Increased affective reactivity to daily social stressors is associated with more severe psychotic symptoms in youths with 22q11.2 deletion syndrome. *Psychological Medicine*, 53(14), 6623–6634.
- Ilen, L., Feller, C. M., & Schneider, M. (2022). Emotion regulation difficulties increase affective reactivity to daily-life stress in

- adolescents and young adults with autism spectrum disorder. *Autism*. <https://doi.org/10.31234/OSF.IO/96w82>
- Ireland, J. L., & Power, C. L. (2004). Attachment, emotional loneliness, and bullying behaviour: A study of adult and young offenders. *Aggressive Behavior*, 30(4), 298–312. <https://doi.org/10.1002/ab.20035>
- Jones, W. H., & Hebb, L. (2003). The experience of loneliness: Objective and subjective factors. *Score Review*, 5(9), 41–68.
- Kates, W. R., Antshel, K. M., Fremont, W. P., Shprintzen, R. J., Strunge, L. A., Burnette, C. P., & Higgins, A. M. (2007). Comparing phenotypes in patients with idiopathic autism to patients with Velocardiofacial syndrome (22q11DS) with and without autism. *American Journal of Medical Genetics, Part A Genetics*, 143(A), 2642–2650. <https://doi.org/10.1002/ajmg.a>
- Kaufman, J., Birmaher, B., Axelson, D., Perepletchikova, F., Brent, D., & Ryan, N. (2016). *K-Sads-Pl Dsm-5*. Pittsburgh: Western Psychiatric Institute and Clinic, 1.
- Kearns, S. M., & Creaven, A. M. (2017). Individual differences in positive and negative emotion regulation: Which strategies explain variability in loneliness? *Personality and Mental Health*, 11(1), 64–74. <https://doi.org/10.1002/pmh.1363>
- Kenworthy, L., Verbalis, A., Bascom, J., daVanport, S., Strang, J. F., Pugliese, C., Freeman, A., Jeppsen, C., Armour, A. C., Jost, G., Hardy, K., & Wallace, G. L. (2022). Adding the missing voice: How self-report of autistic youth self-report on an executive functioning rating scale compares to parent report and that of youth with attention deficit hyperactivity disorder or neurotypical development. *Autism*, 26(2), 422–433. <https://doi.org/10.1177/13623613211029117>
- Kleiman, E. M., Turner, B. J., Fedor, S., Beale, E. E., Huffman, J. C., & Nock, M. K. (2017). Examination of real-time fluctuations in suicidal ideation and its risk factors: Results from two ecological momentary assessment studies. *Journal of Abnormal Psychology*, 126(6), 726–738. <https://doi.org/10.1037/abn0000273>
- Kochenderfer-Ladd, B., & Wardrop, J. L. (2001). Chronicity and instability of children's peer victimization experiences as predictors of loneliness and social satisfaction trajectories. *Child Development*, 72(1), 134–151. <https://doi.org/10.1111/1467-8624.00270>
- Kwan, C., Gitimoghaddam, M., & Collet, J.-P. (2020). Effects of social isolation and loneliness in children with neurodevelopmental disabilities: A scoping review. *Brain Sciences*, 10(11), 786.
- Lasgaard, M., Nielsen, A., Eriksen, M. E., & Goossens, L. (2010). Loneliness and social support in adolescent boys with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 40(2), 218–226. <https://doi.org/10.1007/s10803-009-0851-z>
- Lay, J. C., Pauly, T., Graf, P., Biesanz, J. C., & Hoppmann, C. A. (2019). By myself and liking it? Predictors of distinct types of solitude experiences in daily life. *Journal of Personality*, 87(3), 633–647. <https://doi.org/10.1111/jopy.12421>
- Lim, M. H., Rodebaugh, T. L., Zyphur, M. J., & Gleeson, J. F. M. (2016). Loneliness over time: The crucial role of social anxiety. *Journal of Abnormal Psychology*, 125(5), 620–630. <https://doi.org/10.1037/abn0000162.supp>
- Long, C. R., & Averill, J. R. (2003). Solitude: An exploration of benefits of being alone. *Journal for the Theory of Social Behaviour*, 33(1), 21–44. <https://doi.org/10.1111/1468-5914.00204>
- Lord, C., Rutter, M., DiLavore, P., & Risi, S. (2012). *Autism diagnostic observation schedule 2*. WPS.
- Maes, M., Van Den Noortgate, W., & Goossens, L. (2015). A reliability generalization study for a multidimensional loneliness scale: The loneliness and aloneness scale for children and adolescents. *European Journal of Psychological Assessment*, 31(4), 294–301. <https://doi.org/10.1027/1015-5759/a000237>
- Maes, M., Vanhalst, J., Spithoven, A. W. M., Van den Noortgate, W., & Goossens, L. (2016). Loneliness and attitudes toward aloneness in adolescence: A person-centered approach. *Journal of Youth and Adolescence*, 45(3), 547–567. <https://doi.org/10.1007/s10964-015-0354-5>
- Mazefsky, C. A., Herrington, J., Siegel, M., Scarpa, A., Maddox, B. B., Scahill, L., & White, S. W. (2013). The role of emotion regulation in autism spectrum disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, 52(7), 679–688. <https://doi.org/10.1016/j.jaac.2013.05.006>
- Mazefsky, C. A., Kao, J., & Oswald, D. P. (2011). Preliminary evidence suggesting caution in the use of psychiatric self-report measures with adolescents with high-functioning autism spectrum disorders. *Research in Autism Spectrum Disorders*, 5(1), 164–174. <https://doi.org/10.1016/j.rasd.2010.03.006>
- McCabe, K., Melville, J. L., Rich, D., Strutt, P. A., Cooper, G., Loughland, C. M., Schall, U., & Campbell, L. E. (2013). Divergent patterns of social cognition performance in autism and 22q11.2 deletion syndrome (22q11DS). *Journal of Autism and Developmental Disorders*, 43(8), 1926–1934. <https://doi.org/10.1007/s10803-012-1742-2>
- Mote, J., Gonzalez, R., Kircos, C., Gard, D. E., & Fulford, D. (2020). The relationship between state and trait loneliness and social experiences in daily life. *Preprint*.
- Mund, M., Freuding, M. M., Möbius, K., Horn, N., & Neyer, F. J. (2020). The stability and change of loneliness across the life span: A meta-analysis of longitudinal studies. *Personality and Social Psychology Review*, 24(1), 24–52. <https://doi.org/10.1177/1088868319850738>
- Myin-Germeys, I., Oorschot, M., Collip, D., Lataster, J., Delespaul, P., & Van Os, J. (2009). Experience sampling research in psychopathology: Opening the black box of daily life. *Psychological Medicine*, 39(9), 1533–1547. <https://doi.org/10.1017/S0033291708004947>
- Norkett, E. M., Lincoln, S. H., Gonzalez-Heydrich, J., & D'Angelo, E. J. (2017). Social cognitive impairment in 22q11 deletion syndrome: A review. *Psychiatry Research*, 253(2016), 99–106. <https://doi.org/10.1016/j.psychres.2017.01.103>
- Nuske, H. J., Vivanti, G., & Dissanayake, C. (2013). Are emotion impairments unique to, universal, or specific in autism spectrum disorder? A comprehensive review. *Cognition and Emotion*, 27(6), 1042–1061.
- Palmier-Claus, J. E., Myin-Germeys, I., Barkus, E., Bentley, L., Udachina, A., Delespaul, P. A. E. G., Lewis, S. W., & Dunn, G. (2011). Experience sampling research in individuals with mental illness: Reflections and guidance. *Acta Psychiatrica Scandinavica*, 123(1), 12–20. <https://doi.org/10.1111/j.1600-0447.2010.01596.x>
- Plau, L. A., & Perlman, D. (1982). *Loneliness: A sourcebook of current theory research, and therapy* (Vol. 41, pp. 229–231). John Wiley and Sons. <https://doi.org/10.1037/0003-066X.41.2.229>
- Reich, W. (2000). Diagnostic interview for children and adolescents (DICA). *Journal of the American Academy of Child & Adolescent Psychiatry*, 39(1), 59–66.
- Reissmann, A., Stollberg, E., Hauser, J., Kaunzinger, I., & Lange, K. W. (2021). The role of state feelings of loneliness in the situational regulation of social affiliative behavior: Exploring the regulatory relations within a multilevel framework. *PLoS One*, 16(6), 1–21. <https://doi.org/10.1371/journal.pone.0252775>
- Renk, K., & Phares, V. (2004). Cross-informant ratings of social competence in children and adolescents. *Clinical Psychology Review*, 24(2), 239–254. <https://doi.org/10.1016/j.cpr.2004.01.004>
- Richard, A., Rohrmann, S., Vandeleur, C. L., Schmid, M., Barth, J., & Eichholzer, M. (2017). Loneliness is adversely associated with physical and mental health and lifestyle factors: Results from a Swiss national survey. *PLoS ONE*, 12(7), 1–18. <https://doi.org/10.1371/journal.pone.0181442>
- Roach, A. (2018). Supportive peer relationships and mental health in adolescence: An integrative review. *Issues in Mental Health Nursing*, 39(9), 723–737. <https://doi.org/10.1080/01612840.2018.1496498>

- Russell, M. A., & Gajos, J. M. (2020). Annual research review: Ecological momentary assessment studies in child psychology and psychiatry. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 61(3), 376–394. <https://doi.org/10.1111/jcpp.13204>
- Rutter, M., Bailey, A., & Lord, C. (2003). *Social Communication Questionnaire (SCQ)*. Western Psychological Services.
- Rutter, M., Le Couteur, A., & Lord, C. (2003). *Autism diagnostic interview, revised*. Western Psych Services.
- Samson, A. C., Hardan, A. Y., Podell, R. W., Phillips, J. M., & Gross, J. J. (2015). Emotion regulation in children and adolescents with autism spectrum disorder. *Autism Research*, 8(1), 9–18. <https://doi.org/10.1002/aur.1387>
- Schiltz, H., Gohari, D., Park, J., & Lord, C. (2023). A longitudinal study of loneliness in autism and other neurodevelopmental disabilities: Coping with loneliness from childhood through adulthood. *Autism*, 28(6), 1471–1486. <https://doi.org/10.1177/13623613231217337>
- Schiltz, H., McVey, A. J., Dolan Wozniak, B., Haendel, A. D., Stanley, R., Arias, A., Gordon, N., & Van Hecke, A. V. (2021). The role of loneliness as a mediator between autism features and mental health among autistic young adults. *Autism*, 25(2), 545–555. <https://doi.org/10.1177/1362361320967789>
- Schneider, M., Debbané, M., Bassett, A. S., Chow, E. W. C., Fung, W. L. A., Van Den Bree, M. B. M., Owen, M., Murphy, K. C., Niarchou, M., Kates, W. R., Antshel, K. M., Fremont, W., McDonald-McGinn, D. M., Gur, R. E., Zackai, E. H., Vorstman, J., Duijff, S. N., Klaassen, P. W. J., Swillen, A., ... Eliez, S. (2014). Psychiatric disorders from childhood to adulthood in 22q11.2 deletion syndrome: Results from the international consortium on brain and behavior in 22q11.2 deletion syndrome. *American Journal of Psychiatry*, 171(6), 627–639. <https://doi.org/10.1176/appi.ajp.2013.13070864>
- Schneider, M., Van der Linden, M., Glaser, B., Rizzi, E., Dahoun, S. P., Hinard, C., Bartoloni, L., Antonarakis, S. E., Debbané, M., & Eliez, S. (2012). Preliminary structure and predictive value of attenuated negative symptoms in 22q11.2 deletion syndrome. *Psychiatry Research*, 196(2–3), 277–284. <https://doi.org/10.1016/j.psychres.2011.08.017>
- Schonherz, Y., Davidov, M., Knafo, A., Zilkha, H., Shoval, G., Zalsman, G., Frisch, A., Weizman, A., & Gothelf, D. (2014). Shyness discriminates between children with 22q11.2 deletion syndrome and Williams syndrome and predicts emergence of psychosis in 22q11.2 deletion syndrome. *Journal of Neurodevelopmental Disorders*, 6(1), 2–9. <https://doi.org/10.1186/1866-1955-6-3>
- StataCorp (2019). *Stata statistical software: Release 16*. College Station, TX: StataCorp LLC.
- Sterzing, P. R., Shattuck, P. T., Narendorf, S. C., Wagner, M., & Cooper, B. P. (2012). Bullying involvement and autism spectrum disorders: Prevalence and correlates of bullying involvement among adolescents with an autism spectrum disorder. *Archives of Pediatrics and Adolescent Medicine*, 166(11), 1058–1064. <https://doi.org/10.1001/archpediatrics.2012.790>
- Sundberg, M. (2018). Online gaming, loneliness and friendships among adolescents and adults with ASD. *Computers in Human Behavior*, 79, 105–110. <https://doi.org/10.1016/j.chb.2017.10.020>
- Tang, L., Kates, W. R., Antshel, K. M., & Fremont, W. P. (2015). Behavioral and psychiatric phenotypes in 22q11.2 deletion syndrome. *Journal of Developmental and Behavioral Pediatrics*, 36(8), 639–650. <https://doi.org/10.1097/DBP.0000000000000210>
- van Roekel, E., Ha, T., Verhagen, M., Kuntsche, E., Scholte, R. H. J., & Engels, R. C. M. E. (2015). Social stress in early adolescents' daily lives: Associations with affect and loneliness. *Journal of Adolescence*, 45, 274–283. <https://doi.org/10.1016/j.adolescence.2015.10.012>
- van Roekel, E., Keijsers, L., & Chung, J. M. (2019). A review of current ambulatory assessment studies in adolescent samples and practical recommendations. *Journal of Research on Adolescence*, 29(3), 560–577. <https://doi.org/10.1111/jora.12471>
- van Roekel, E., Verhagen, M., Engels, R. C. M. E., Scholte, R. H. J., Cacioppo, S., & Cacioppo, J. T. (2018). Trait and state levels of loneliness in early and late adolescents: Examining the differential reactivity hypothesis. *Journal of Clinical Child and Adolescent Psychology*, 47(6), 888–899. <https://doi.org/10.1080/15374416.2016.1146993>
- Vorstman, J. A. S., Breetvelt, E. J., Duijff, S. N., Eliez, S., Schneider, M., Jalbrzikowski, M., Armando, M., Vicari, S., Shashi, V., Hooper, S. R., Chow, E. W. C., Fung, W. L. A., Butcher, N. J., Young, D. A., McDonald-McGinn, D. M., Vogels, A., Van Amelsvoort, T., Gothelf, D., Weinberger, R., ... Pontillo, M. (2015). Cognitive decline preceding the onset of psychosis in patients with 22q11.2 deletion syndrome. *JAMA Psychiatry*, 72(4), 377–385. <https://doi.org/10.1001/jamapsychiatry.2014.2671>
- Warnick, E. M., Bracken, M. B., & Kasl, S. (2008). Screening efficiency of the child behavior checklist and strengths and difficulties questionnaire: A systematic review. *Child and Adolescent Mental Health*, 13(3), 140–147. <https://doi.org/10.1111/j.1475-3588.2007.00461.x>
- Wechsler, D. (2011). *Wechsler adult intelligence scale-IV: Administration and scoring manual*. The Psychological Corporation.
- Wechsler, D. (2014). *Wechsler intelligence scale for children* (5th ed.). Pearson.
- Wilson, C., Anthony, L., Kenworthy, L., Fleischman, R., Demro, C., Andorko, N., Chelsea Armour, A., & Schiffman, J. (2020). Feasibility of psychosis risk assessment for adolescents diagnosed with autism. *Autism*, 24(4), 834–850. <https://doi.org/10.1177/1362361320909173>
- Yung, S. T., Chen, Y., & Zawadzki, M. J. (2021). Loneliness and psychological distress in everyday life among Latinx college students. *Journal of American College Health*, 71(2), 1–10. <https://doi.org/10.1080/07448481.2021.1927051>
- Zeidan, J., Fombonne, E., Scorch, J., Ibrahim, A., Durkin, M. S., Saxena, S., Yusuf, A., Shih, A., & Elsabbagh, M. (2022). Global prevalence of autism: A systematic review update. *Autism Research*, 15(5), 778–790. <https://doi.org/10.1002/aur.2696>

## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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