Daily Survey of Negative Affect and Social Interactions in Young Adults with High Levels of Social Stress

Danica L. Limon
Brigham Young University

Follow this and additional works at: https://scholarsarchive.byu.edu/etd

Part of the Family, Life Course, and Society Commons

BYU ScholarsArchive Citation
Limon, Danica L., "Daily Survey of Negative Affect and Social Interactions in Young Adults with High Levels of Social Stress" (2022). Theses and Dissertations. 9670.
https://scholarsarchive.byu.edu/etd/9670

This Thesis is brought to you for free and open access by BYU ScholarsArchive. It has been accepted for inclusion in Theses and Dissertations by an authorized administrator of BYU ScholarsArchive. For more information, please contact ellen_amatangelo@byu.edu.
Daily Survey of Negative Affect and Social Interactions in Young Adults with High Levels of Social Stress

Danica L. Limon

A thesis submitted to the faculty of Brigham Young University in partial fulfillment of the requirements for the degree of Master of Science

Rebecca A. Lundwall, Chair
Mikle South
Terisa Gabrielsen

Department of Psychology
Brigham Young University

Copyright © 2022 Danica L. Limon
All Rights Reserved
ABSTRACT

Daily Survey of Negative Affect and Social Interactions in Young Adults with High Levels of Social Stress

Danica L. Limon
Department of Psychology, BYU
Master of Science

Background: Few studies have focused on the contextual influences that impact negative affect (NA) and risk for mood disorders in young adults. Research using ecological momentary assessment (EMA) methods has shown that neurotypical adults with elevated social anxiety may be more sensitive to their social environment. To date, little is known about how types of social interactions impact autistic adults, who may show varying levels of social anxiety and social motivation. Aim: Our goal was to examine the heterogeneity in daily social experiences for autistic and socially anxious adults. Method: Using EMA surveys, we tracked daily self-reported face-to-face interactions and examined how these interactions influenced daily affect. We likewise examined how social anxiety (using the Liebowitz Social Anxiety Scale) and autism traits (using the Autism Spectrum Quotient) influenced day-to-day social experiences while controlling for potential covariates (age and biological sex). Participants consisted of 88 young adults who participated in a mental health longitudinal study. We used a multilevel model approach (MLM) to examine predictors of NA. Results: MLM analysis showed that a model with face-to-face interactions and social anxiety predictors best explained outcomes in NA. AQ scores, age, and sex covariates did not improve model fit. Social anxiety was a significant negative predictor of NA after controlling for face-to-face interaction. Conclusion: These findings highlight that autism traits do not predict NA after controlling for social anxiety, and that social anxiety interventions may improve overall moods by addressing types of interactions.

Keywords: Ecological Momentary Assessment, EMA, autism, social anxiety, negative affect
ACKNOWLEDGEMENTS

I would like to thank my mentors Rebecca Lundwall and Mikle South for the countless hours they spent encouraging, guiding, and supporting me on this project. I would also like to thank Terisa Gabrielsen for being a part of my thesis committee and imparting her knowledge and expertise in autism research. Thank you to Daniel South for assistance with data preparation and to Dr. Nielsen’s team for their hard work in collecting the data. Lastly, I would like to acknowledge my family, BYU friends, and especially my partner James—who has been my strongest supporter and best friend throughout the challenges of life.
# TABLE OF CONTENTS

Title Page .................................................................................................................................................i

ABSTRACT ...................................................................................................................................................ii

ACKNOWLEDGEMENTS ...........................................................................................................................iii

LIST OF TABLES ........................................................................................................................................vi

LIST OF FIGURES .....................................................................................................................................vii

Daily Survey of Negative Affect and Social Interactions in Young Adults with High Levels of Social Stress .................................................................................................................................1

  Negative Affect and Social Stress ...........................................................................................................1

  Social Anxiety and Autism ......................................................................................................................1

  Current Study ..........................................................................................................................................3

Methods .........................................................................................................................................................4

  Participants ..............................................................................................................................................4

    Safety Protections .................................................................................................................................5

    Compensation ....................................................................................................................................6

Procedures ..................................................................................................................................................7

Measures ......................................................................................................................................................9

  MetricWire Phone Surveys ....................................................................................................................9

  Emotionality and Social Interaction .......................................................................................................10

  Social anxiety ........................................................................................................................................10

  Autism Quotient ..................................................................................................................................10

Data Analysis ............................................................................................................................................11

Results .......................................................................................................................................................16
Discussion......................................................................................................................................23
Limitations ......................................................................................................................................24
Future Directions..........................................................................................................................25
Conclusion .......................................................................................................................................25
References.......................................................................................................................................27
LIST OF TABLES

Table 1 Demographic Summary ...........................................................................................................5

Table 2 Outline of Measures and Timelines .........................................................................................8

Table 3 Elements of Statistical Models .................................................................................................15

Table 4 A Summary of Key Models Evaluated .....................................................................................15

Table 5 Descriptive Statistics .................................................................................................................16

Table 6 Multilevel Models Predicting Daily Negative Affect .................................................................21
LIST OF FIGURES

Figure 1 Relationship Between Social Anxiety (LSAS) and Negative Affect ..............................................12
Figure 2 Individual Slopes of Variation in Negative Affect Across Days in Study........................................14
Figure 3 Negative Affect (NA) per Diagnostic Group ..............................................................................17
Figure 4 Social Anxiety (LSAS) per Diagnostic Group .............................................................................18
Figure 5 Autism Traits per Diagnostic Group .......................................................................................18
Daily Survey of Negative Affect and Social Interactions in Young Adults with High Levels of Social Stress

Negative Affect and Social Stress

Dispositional negativity, often referred to as “neurotic traits,” "negative emotionality," or “negative affect,” is a critical component of temperament and personality (Shackman et al., 2018). Negative affect (NA) is often explored in emotion and self-regulation studies as an important transdiagnostic risk factor for mental health disorders (e.g., depression and anxiety; Gable et al., 2000; Cai et al., 2018b). Studies focused on the situational influences that contribute to NA show that individuals with higher levels of NA typically have heightened stress responses to daily stressors and interpersonal conflicts (Gable et al., 2000; Shackman et al., 2018). Given this idea that daily social functioning impacts overall affect and emotional outcomes, it is worth examining how individuals who are vulnerable to social stress respond to social interaction.

Clinical samples who may be prone to social stress involve those who feel an increased need to monitor their social interactions (Farmer & Kashdan, 2015), those who have experienced adverse social events (Spain et al., 2020), and those who have challenges interpreting social situations or modifying reappraisals of the social situation (e.g., changing negative thoughts about the situation). Such challenges are often seen among individuals diagnosed with social anxiety, and in autistic individuals (Cai et al., 2019; Hur et al., 2020).

Social Anxiety and Autism

Social anxiety disorder (SAD; also called “social phobia”) is defined as a fear of negative evaluation or criticism in social situations (Ramirez et al., 2021) and affects nearly 15 million American adults (De Castella et al., 2015). Symptoms include reduced confidence in social settings, increased avoidance of such situations, social isolation, and distorted generalization to
subsequent social interactions. Physical symptoms include heightened arousal (e.g., rapid heartbeat, sweating, and trembling; Maddox & White, 2015). SAD commonly occurs between adolescence and early adulthood and is best to treat early (Maddox & White, 2015; Scaini et al., 2016). When untreated, childhood anxiety disorders such as social anxiety can have chronic and pervasive effects into adulthood, which worsen mental health outcomes (Lijster et al., 2017).

Symptoms of social anxiety can also translate to social skills deficits (Scaini et al., 2016). Individuals with clinical social anxiety tend to have smaller social and support networks, poorer school performance, and increased vulnerability for other mental disorders compared to non-socially anxious peers (Kerns et al., 2013). Social anxiety is common among autistic individuals alongside differences in social functioning (Spain et al., 2018; Maddox & White, 2015). Studies have shown that up to 40% of autistic adults from a clinical sample would likewise meet diagnostic criteria for SAD (Spain et al., 2020). Autistic individuals may experience added pressures to navigate social interactions with neurotypical peers–this may come up in face-to-face interactions and make them feel like they need to camouflage or mask their communicative differences (Hull et al., 2017). Further, autistic individuals may feel misunderstood by neurotypical peers (e.g., the double empathy problem), which makes them more susceptible to experiencing anxiety (Spain et al., 2020; Hunsche et al., 2022). Overall, certain social demands such as face-to-face social interactions may be overwhelming for some autistic individuals and leads to greater pressure on coping and emotion regulation strategies (Cummins et al., 2020).

Previous research identified that individuals with higher social anxiety may be impacted by their typical social interactions—these individuals tended to have fewer close companions, less interactions with companions, and higher NA (Hur et al., 2020). However, limited research
has been done with autistic samples and whether autism-related traits impact emotional outcomes beyond co-occurring social anxiety symptoms. Social challenges may especially be elevated for autistic young adults who experience major life transitions, such as those adjusting to changes in their social support network and forging new relationships when they enter college/university (Gurbuz et al., 2019; Shackman et al., 2018). Autistic individuals have varying levels of motivation to create and maintain friendships and may have a desire to seek out increased social interactions in modalities that are more comfortable and enjoyable for them (Crompton et al., 2020; Cummins et al., 2020). But while levels of social comfort vary across autistic people, many studies report pressures to camouflage and/or feeling misunderstood by others that decrease social enjoyment (Hull et al., 2017; Hunsche et al., 2022).

**Current Study**

Research indicates that neurotypical individuals with heightened social anxiety may be sensitive to the context of their daily social interactions, and therefore may experience changes in their NA based on such interactions (Hur et al., 2020). Given that autistic individuals have varying levels of social motivation (Lei et al., 2020) and may experience social interactions in different ways than anxious neurotypical peers, it’s worth exploring whether these same relationships hold in autism. The aim of this study was to examine the relationship between face-to-face interactions and daily emotionality or NA across three age-matched young adults including: 1) young adults with SAD but not autism; 2) young adults diagnosed with autism who vary in levels of social anxiety; and 3) a non-clinical comparison sample. Further, we wanted to see how individual traits of social anxiety and autism impact emotional outcomes. We hypothesized that social anxiety traits would have a strong influence on overall affect in the context of face-to-face social interactions. We expected this interaction due to the increased
interpersonal opportunities that this mode of interaction provides (Okdie et al., 2011). In light of the high overlap between autism and anxiety (Maddox & White, 2015), we also hypothesized that autism traits would have some predictive influence on affect outcomes, but that it would not increase the likelihood of NA after controlling for social anxiety. In other words, we expected social anxiety to explain the likelihood of NA more than autism traits.

As part of a larger Young Adult Health Study completed at Brigham Young University (BYU), we gathered data using daily Ecological Momentary Assessment (EMA; Terhorst et al., 2017) surveys for this study. Examining social interactions and mood fluctuations requires time-sensitive data collection methods. EMA surveys capture dynamic changes in environmental and social contexts (Hur et al., 2020; Sedano-Capdevila et al., 2021). We also administered health and mental health surveys during lab-based visits.

Methods

Participants

Our sample consisted of 88 young adults recruited from the ongoing Young Adult Health EMA study at BYU that specifically recruited participants who experienced suicidal thoughts and behaviors. Participants with diagnosed social anxiety disorder or autism as well as young adults with no history of diagnosed or suspected clinical mental health concerns were recruited. Participants were recruited through flyers, electronic advertisements, and word-of-mouth, including flyers posted in public areas around several local university campuses and university counseling clinics, as well from our existing research database. Potential participants completed an eligibility phone screening.

We specifically recruited young adults who experience suicidal thoughts and behaviors (STBs; \( n = 63 \)) in addition to a comparison group without notable STBs \( (n = 25) \). A total of 5
individuals who were recruited did not participate in the study due to not meeting eligibility requirements or meeting exclusionary criteria. Eligibility for the study included age 18 years or older, being fluent in English, access to an iPhone or Android smartphone\(^1\) to download the necessary data collection instruments, and willingness to report twice-daily (morning and evening) reports of emotion and behavior including STBs. Exclusion criteria included any diagnosis of schizophrenia, bipolar disorder, or personality disorder, and individuals with major medical concerns. Eligible individuals were scheduled for a Baseline Visit at the BYU Comprehensive Clinic where they were given further information on the study and provided consent for participation.

**Table 1**

*Demographic Summary*

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>N</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>65</td>
<td>73.9%</td>
</tr>
<tr>
<td>Male</td>
<td>23</td>
<td>26.1%</td>
</tr>
<tr>
<td>Racial Category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>77</td>
<td>87.5%</td>
</tr>
<tr>
<td>Asian</td>
<td>3</td>
<td>3.4%</td>
</tr>
<tr>
<td>Hispanic or Latinx</td>
<td>8</td>
<td>9.1%</td>
</tr>
<tr>
<td>Diagnostic Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autism</td>
<td>30</td>
<td>34.1%</td>
</tr>
<tr>
<td>Control</td>
<td>27</td>
<td>30.7%</td>
</tr>
<tr>
<td>Social Anxiety</td>
<td>31</td>
<td>35.2%</td>
</tr>
</tbody>
</table>

\(^1\) One participant without a smartphone was provided one for the duration of the study.
Safety Protections

Individuals who did not meet eligibility requirements because of additional psychiatric concerns were asked whether they would want to remain on a recruitment list for future studies and were given information on mental health intervention and prevention resources. At time of enrollment, every participant completed a safety plan with a clinician regarding individual coping strategies, support systems, and local crisis resources. A copy of the plan was given to the individual participant and saved in a secure digital folder that only clinicians had access too. Every morning and evening survey included an option to be contacted by a clinician; when the option was selected, a text was sent to PIs who are licensed psychologists and the individual was immediately contacted by phone or text or email until they responded, and a crisis plan was implemented.

As much of this study took place during the worldwide coronavirus pandemic, clinical interviews for some participants (e.g., MINI, CSSR-S) were conducted virtually via Zoom. Some participants also completed remotely administered ADOS Module 4 following Schutte et al. (2015). In-person lab visits required individuals to be fitted with the actigraphy watches and complete online surveys from a lab computer. Participants and the attending research assistant were all required to wear appropriate masks and to maintain proper physical distance. All surfaces and equipment were sanitized between each visit.

Compensation

Individuals who did not meet eligibility requirements were compensated $15 for every hour that they participated in screening questionnaires and testing. Those who did meet eligibility criteria were told that there would be 5 in-lab visits (approximately 6-weeks apart), which totaled to approximately 10 hours of participation. Participants received $15 an hour for
every lab visit they completed. They also received $1 for every day that they reported daily measures (e.g., completing the morning and evening surveys using the Metricwire app). Participants earned “Milestone bonuses;” which included $20 for individuals who completed 50% - 70% of the surveys and actigraphy days, and $50 for those who completed >75% of the surveys and actigraphy days. Altogether, individuals in the clinical group had an opportunity to earn up to $418, and those in the non-clinical group could earn up to $403 (the non-clinical group was not given the ADOS-2; Lord et al., 2012; thus, had one less evaluation to complete). Compensation was disbursed at the halfway point and at the end of the study. Individuals who withdrew their participation early received compensation at a prorated amount. Individuals who were in the >75% compliance range were invited to enroll in the bonus 3-month data collection period where they could receive up to an additional $175 for their participation.

Procedures

Participants were asked to attend five in-person lab visits to complete additional questionnaires and assessments at regularly spaced intervals throughout the study. A complete list of measures and timeline for this study are summarized in Table 2. All measures with an asterisk (*) were analyzed in the current manuscript and are described here. It should be noted that our analysis excluded participants \( n = 9 \) who contributed less than a week’s worth of data. Most of these participants only provided 1 day worth of data before deciding not to continue with the study. Additionally, 3 participants were excluded from our analysis due to software error during data collection. Of those who completed all five lab visits over the course of six months, 41 accepted the invitation to continue for two more visits over three additional months.
### Table 2
Outline of Measures and Timelines

<table>
<thead>
<tr>
<th>Visit</th>
<th>Measures</th>
</tr>
</thead>
</table>
| Visit 1 | ● M.I.N.I. screening assessment for diagnosis  
          ● Autism Diagnostic Observation Schedule (ADOS, Module 4)  
          ● Columbia Suicide Severity Rating Scale Baseline/Lifetime (C-SSRS)  
          ● Demographic questionnaire  
          ● Sleep questionnaires: Pittsburgh Sleep Quality Index; PROMIS-Sleep Disturbance Short Form; Insomnia Severity Index  
          ● Autism Spectrum Quotient (AQ) *  
          ● Liebowitz Social Anxiety Scale (LSAS) *  
          ● Questionnaires related to social interactions: social media use, social abilities *  
          ● Treatment questionnaires (e.g., therapy and medication)  
          ● GENEActiv actigraphy device  
          ● MetricWire set-up  
          ● Install measures to record phone screen time or app usage. |
| Visit 2 | ● C-SSRS SLV – “Since Last Visit” version  
          ● National Institutes of Health “Toolbox” Questionnaires  
          ● 2-subtest version of the Wechsler Abbreviated Scales of Intelligence – 2nd Edition  
          ● Sleep questionnaires  
          ● Treatment  
          ● Self-Harm questionnaire  
          ● Mental health check-up  
          ● Actigraph check-in  
          ● Phone usage  
          ● Binocular Rivalry |
| Visit 3 | ● CASS (Contextual Assessment of Social Skills)  
          ● C-SSRS SLV – “Since Last Visit” version  
          ● Actigraph check-in  
          ● Phone usage  
          ● Sleep questionnaires  
          ● Mental health check-up  
          ● Binocular rivalry task |
| Visit 4 | ● CASS  
          ● Sleep questionnaires  
          ● Mental health check-up  
          ● C-SSRS SLV – “Since Last Visit” version  
          ● Actigraph check-in  
          ● Phone usage |
- Binocular rivalry task (if wasn’t conducted at Visit 3)
- COVID questions

<table>
<thead>
<tr>
<th>Visit 5</th>
</tr>
</thead>
</table>
| - Sleep questionnaires  
- Treatment  
- Mental Health Check-up  
- Self-Harm  
- NIH Toolbox questionnaires  
- Social interaction questionnaires  
- C-SSRS SLV – “Since Last Visit” version  
- Binocular rivalry task (if wasn’t done twice)  
- CASS (if wasn’t done twice)  
- Phone usage  
- Actigraph turn-in, phone usage, and SMS download  
- Autism Spectrum Quotient (AQ) *  
- Liebowitz (LSAS) *  
- Questionnaires related to social interactions: social media use, social abilities * |

<table>
<thead>
<tr>
<th>Visit 6 &amp; 7 (Optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Similar to Visits 3 &amp; 4</td>
</tr>
</tbody>
</table>

Note. Participants were asked to wear a GENEActiv actigraphy device to track the individuals’ physical activity and sleep patterns. Participants who completed the study virtually did not complete the Binocular Rivalry task. Additionally, some participants opted to not provide Binocular Rivalry data if the equipment was physically uncomfortable (e.g., if participants complained of headaches).

**Measures**

**MetricWire Phone Surveys**

As part of the larger YA Health Study, participants were asked to complete twice-daily (morning and evening), smartphone based EMAs using the MetricWire app which a research assistant installed on the participant’s smartphone. The surveys specifically assessed individual health status, sleep patterns, physical activity, spirituality, stress, diet, mood, social media use, social support, depression, anxiety, and suicidal thoughts. The morning survey consisted of 17 questions, which included a 2-minute auto diary where participants provided details about how
they felt yesterday and how they are currently feeling. The morning survey took about 5 minutes to complete. The evening survey consisted of 36 questions and took approximately 8 minutes to complete. The data that we used for analysis was specifically collected from the evening survey, which allowed us to look at the participants’ affect at the end of the day as better indicators of contextual influences throughout the day.

**Emotionality and Social Interaction**

Based on the work of previous researchers (Gross and John, 2003; Cai et al., 2018a; Cai et al., 2018b; Cai et al., 2019; Troy et al., 2010) we created questions to address daily NA. To assess daily affect in our sample, we pulled a question that probed for negative feelings (e.g., anxiety, anger, sadness, and irritability) in the past 24 hours. Question responses were in a Likert scale format. Responses ranged from: None at all or very slightly (0 – 19), A little (20-39), Moderately (40 – 59), Quite a bit (60 – 79), and Extremely (80 – 100). We focused on these NA questions given emotion regulation differences in autistic groups and typically developing groups (e.g., flexibility in adapting and implementing strategies to regulate emotions; Cai et al., 2019). To assess daily social interaction, we analyzed how connected the participant felt to others in face-to-face interactions during the past 24 hours.

**Social Anxiety**

We used the Liebowitz Social Anxiety Scale (LSAS) to measure self-report ratings of trait social anxiety (Liebowitz, 1987). The LSAS is a 24-item measure using a 0-3 severity scale. Individuals self-report their level of anxiety to 24 social prompts/scenarios and their level of avoidance to such situations. The total sum of responses from both the anxiety and avoidance ratings comprises the social anxiety composite. The LSAS total score and subscales are normally
distributed and have shown to have high internal consistency, convergent validity, and sensitivity (Heimberg et al., 1999). As shown in Table 2, the LSAS was only gathered in Visits 1 and 5.

**Autism Quotient**

The Autism Spectrum Quotient (AQ) was used to measure diagnostic self-reports of autism traits. The AQ is a screening tool that uses Likert-scale response items (items range from Definitely Agree to Definitely Disagree and are given a value of 1 - 4 respectively) indicating participant agreement with 50 statements (Baron-Cohen et al., 2001; Lundqvist & Lindner, 2017). These statements assess areas of social skill, attention switching, communication, and imagination (Baron-Cohen et al., 2001). Previous studies have shown that the AQ has adequate test-retest reliability and good sensitivity and specificity in measuring the degree of autistic traits in individuals (Lundqvist & Lindner, 2017). AQ scores were gathered in Visits 1 and 5.

**Data Analysis**

Our intent was to assess the extent to which daily face-to-face social interaction impacts daily NA over time. Secondly, we wanted to determine if a social anxiety score (LSAS) explains any additional variance in NA, after controlling for face-to-face social interaction (see Figure 1 for association between LSAS and NA). We also wanted to determine if autism scores impact the NA outcome. After controlling for face-to-face interaction, we chose to enter social anxiety scores then enter autism trait scores; reasoning that social anxiety would be more influential on the NA scores.
Figure 1

*Relationship Between Social Anxiety (LSAS) and Negative Affect*

Note. This figure demonstrates the overall upward trend between social anxiety and negative affect prior to including face-to-face interactions.

We decided to use multilevel modeling for this analysis, i.e., as a nested linear regression (formula for a line) that considers not all observations are independent because there are many observations per participant for most of our data). This limits violation of assumption of OLS regression that involve homogeneity of error terms. We used IBM SPSS 28 statistical software package to conduct the analysis. We created a scatter plot of the daily NA of a randomly selected one-third of participants to assess whether there were significant outliers in the data (see Figure 2). The wide variability in starting point and response slopes between participants suggested that a model with random slopes and intercepts best reflected the actual data. Further, an intraclass
correlation of 0.56 suggests that the data cannot be understood without using a multilevel model (Maas & Hox, 2005). These tools helped guide the decision to use MLM.

MLM typically requires that predictors be centered to be interpreted in terms of the typical day or the typical participant. The face-to-face interaction variable (a level-1 or daily variable) was group-mean centered to indicate each day’s deviation from an individual’s daily average. Centering in this way and including the face-to-face interaction variable as a fixed effect allows disaggregation of within-individual and between-individual variance. Level 2 data points (AQ scores, LSAS score, and age) were centered to the grand mean because all groups (i.e., individuals) were measured using the same criteria and there was no within group variability for level-2 variables (i.e., we used the earliest AQ and LSAS scores the study provided). Sex was not centered because it is a nominal variable. Our decisions were supported by Bliese (2002), who argued that conclusions that are able to be drawn will depend on the researchers’ centering choices and should reflect the research question in mind.
Figure 2

*Individual Slopes of Variation in Negative Affect Across Days in Study*

Note. This figure represents a random sample of one-third of individuals in the data set. The dependent variable (NA) is on the Y-axis and the day in the study is on the X-axis.

Our sample had missing data that was likely due to participant difficulty completing EMA surveys (e.g., remembering to complete EMAs, missing a visit at which a questionnaire was administered). However, one advantage to MLM is that missing data are less of a problem because level-1 data (days) is stored in its own row with level 2 data (individual) repeated across the rows of days for that individual. Missing data, although handled via listwise deletion, is less problematic because the rest of an individual’s timepoints data can still be used to make accurate estimations about our outcome variable. Further, MLM allows random slopes and intercepts for each individual and their time slopes, so moderate amounts of missing data are unlikely to
change overall estimation in the outcome variable (Heck et al., 2013). Like other regression-based analysis, MLM is susceptible to multicollinearity. Therefore, we ran a diagnostic correlational analysis between LSAS and AQ to determine whether these two predictors were closely related in which case, one should be excluded as a predictor: \( r(78) = .48, p < .001 \). Our analysis showed that the two were distinct enough to be considered independent variables, and that multicollinearity was likely not an issue in our data. The place of each variable within the model is outlined in Table 3 and the tested models are outlined in Table 4.

Table 3

Elements of Statistical Models

<table>
<thead>
<tr>
<th>Variable</th>
<th>Purpose in Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Affect (Daily)</td>
<td>Outcome</td>
</tr>
<tr>
<td>f2fInteraction (face-to-face)</td>
<td>Predictor</td>
</tr>
<tr>
<td>Age</td>
<td>Predictor (Covariate)</td>
</tr>
<tr>
<td>Biological Sex</td>
<td>Predictor (Covariate)</td>
</tr>
<tr>
<td>AQ (Autism Quotient)</td>
<td>Predictor</td>
</tr>
<tr>
<td>LSAS (Liebowitz Social Anxiety Scale)</td>
<td>Predictor</td>
</tr>
</tbody>
</table>

Table 4

A Summary of Key Models Evaluated

<table>
<thead>
<tr>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Affect = time + error</td>
</tr>
<tr>
<td>Negative Affect = time(_{i}) + error</td>
</tr>
<tr>
<td>Negative Affect = time(<em>{i}) + b(</em>{1})*[f2f interaction] + error</td>
</tr>
<tr>
<td>Negative Affect = time(<em>{i}) + b(</em>{1})*[f2f interaction] + b(_{2})*LSAS + error</td>
</tr>
<tr>
<td>Negative Affect = time(<em>{i}) + b(</em>{1})*[f2f interaction] + b(<em>{2})*LSAS + b(</em>{3})*AQ + error</td>
</tr>
<tr>
<td>Negative Affect = time(<em>{i}) + b(</em>{1})*[f2f interaction] + b(<em>{2})*LSAS + b(</em>{4})*covariates + error</td>
</tr>
</tbody>
</table>
Note. The mathematical notation is $Y_{ij} = y_{00} + y_{01}W + y_{10}X + y_{11}W*X + u_{0j} + u_{1j}*X + r_{ij}$. In the simplified version in the table above, time, indicates each individual’s slope being allowed to vary. Adding AQ did not improve the model and so was removed, and covariates were added (however, they were also not significant).

**Results**

Descriptive statistics are shown in Table 5. On average, participants in our sample endorsed a moderate level (Mennin et al., 2002) of social anxiety in their LSAS scores —though, not all participants endorsed clinically significant social anxiety. Mean AQ scores fell in the low probability range of autism (Bezemer et al., 2021) in our overall sample. The number of daily EMAs ranged from 9 days to 256 days (*referred to as Days In Study below*). The average participant reported some suicidal ideation on approximately 9% of the surveys they completed.

**Table 5**

*Descriptive Statistics*

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative Affect (NA)</td>
<td>88</td>
<td>43.7</td>
<td>15.7</td>
<td>11.42 - 92.83</td>
</tr>
<tr>
<td>f2fInteract</td>
<td>88</td>
<td>46.8</td>
<td>9.8</td>
<td>9.70 - 73.84</td>
</tr>
<tr>
<td>Age</td>
<td>88</td>
<td>23.7</td>
<td>3.8</td>
<td>18.00 - 40.00</td>
</tr>
<tr>
<td>AQ Score</td>
<td>88</td>
<td>23.1</td>
<td>8.7</td>
<td>8.00 - 46.00</td>
</tr>
<tr>
<td>LSAS Score</td>
<td>77</td>
<td>69.8</td>
<td>26.0</td>
<td>26.00 - 128.50</td>
</tr>
<tr>
<td>Days In Study</td>
<td>88</td>
<td>142.0</td>
<td>70.7</td>
<td>9.00 - 256.00</td>
</tr>
<tr>
<td>Percentage Suicidal in Last 12 Hours</td>
<td>88</td>
<td>8.8</td>
<td>14.4</td>
<td>0 - 67.58</td>
</tr>
</tbody>
</table>

Our control group tended to experience less NA compared to both the autism and socially anxious groups. Higher rates of NA among our clinical groups coincides with previous research showing that autistic individuals and socially anxious individuals are susceptible to experiencing NA due to emotion regulation difficulties (Cai et al., 2018a; Hur et al., 2020). On average, LSAS
scores were high in both autism and socially anxious groups. The socially anxious group seemed to demonstrate more autistic traits than the control group but were not elevated enough to meet a score indicating probability of autism. Figures 3 - 5 show NA, LSAS, and AQ scores per diagnostic group (i.e., autism, control, and socially anxious group).

**Figure 3**

*Negative Affect (NA) per Diagnostic Group*
Figure 4

*Social Anxiety (LSAS) per Diagnostic Group*

![Social Anxiety (LSAS) per Diagnostic Group](image)

Figure 5

*Autism Traits per Diagnostic Group*

![Autism Traits per Diagnostic Group](image)
We ran six multilevel models (see Table 6) and incorporated a hierarchy of predictors. Our model is built on a reduced model with only time point as a predictor and added predictors and covariates, comparing each subsequent model to the previous model to determine if there was improved model fit. We used Schwarz’s Bayesian Information Criterion (BIC) to determine improved fit using the “smaller is better” rule (Vallejo et al., 2011). We first ran base models (models 1 and 2) with only time as a predictor. We then compared it to our third model, which showed significant improvement ($\chi^2[5, N = 13073] = 74894.83, p = < 0.00$) when it included group (individual) mean centered face-to-face interaction as a level 1 predictor. Face-to-face interaction was a positive predictor of NA ($B = 0.041, SE = 0.242, p = < 0.867$). This showed that within each individual’s own set of repeated daily measures, face-to-face interactions tended to be associated with increases in NA, but this was not significant. We continued to add predictors to our model to explore variables that account for shared variability and similarities in affect outcomes. Our next model added LSAS scores. This showed a significant improvement from our previous model, indicating that LSAS was an appropriate level 2 predictor of negative affect ($\chi^2(1, N = 13073) = 4972.85, p = 0.00$). Social anxiety was a negative predictor of NA ($B = -0.271, SE = 0.075, p = < 0.001$) – indicating that for every unit increase in social anxiety, we can expect a decrease in overall NA in the sample. We proceeded to analyze whether using AQ as a level 2 variable would provide additional predictive value and improve the fit of the model. However, adding AQ did not improve the fit of the model ($X^2 (1, N = 13073) = -3.88, p = NS$). This shows that adding AQ did not explain the relationship between face-to-face interaction and NA after controlling for social anxiety. We removed AQ and analyzed whether a model with age and sex covariates improved the fit of the previous model. Adding age and sex covariates
resulted in a reduced model fit ($X^2 (1, \, N = 13073) = -10.32, \, p = NS$). As a result, we identified that a model with face-to-face and LSAS predictors best accounted for changes in NA.
### Table 6

**Multilevel Models Predicting Daily Negative Affect**

<table>
<thead>
<tr>
<th>Fixed Parameters</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( B )</td>
<td>( SE )</td>
<td>( p )</td>
</tr>
<tr>
<td>Intercept</td>
<td>43.994</td>
<td>1.636</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Time</td>
<td>-0.001</td>
<td>0.002</td>
<td>0.638</td>
</tr>
<tr>
<td>F2F social (Level-1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSAS (Level-2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AQ (Level-2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Covariance Parameters</strong></td>
<td>( B )</td>
<td>( SE )</td>
<td>( Wald Z )</td>
</tr>
<tr>
<td>Repeated (Time)</td>
<td>300.600</td>
<td>3.738006</td>
<td>80.417</td>
</tr>
<tr>
<td>Intercept</td>
<td>236.060</td>
<td>35.375</td>
<td>6.673</td>
</tr>
<tr>
<td>Number of Parameters</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIC</td>
<td>111723.687</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

21
<table>
<thead>
<tr>
<th>Fixed Parameters</th>
<th>Model 4</th>
<th></th>
<th>Model 5</th>
<th></th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>43.660</td>
<td>10.923</td>
<td>&lt;.001</td>
<td>38.492</td>
<td>10.728</td>
</tr>
<tr>
<td>Time</td>
<td>0.021</td>
<td>1.949</td>
<td>0.992</td>
<td>0.028</td>
<td>1.855</td>
</tr>
<tr>
<td>F2F social (Level-1)</td>
<td>0.050</td>
<td>0.221</td>
<td>0.823</td>
<td>0.122</td>
<td>0.214</td>
</tr>
<tr>
<td>LSAS (Level-2)</td>
<td>-0.271</td>
<td>0.075</td>
<td>&lt;.001</td>
<td>-0.181</td>
<td>0.083</td>
</tr>
<tr>
<td>AQ (Level-2)</td>
<td></td>
<td></td>
<td></td>
<td>-0.521</td>
<td>0.243</td>
</tr>
</tbody>
</table>

**Age**

**Sex**

<table>
<thead>
<tr>
<th>Covariance Parameters</th>
<th>Model 4</th>
<th></th>
<th>Model 5</th>
<th></th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repeated (Time)</td>
<td>311.780</td>
<td>7.233</td>
<td>43.103</td>
<td>&lt;.001</td>
<td>311.838</td>
</tr>
<tr>
<td>Number of Parameters</td>
<td>6</td>
<td></td>
<td>7</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>BIC</td>
<td>32827.21</td>
<td></td>
<td>32831.09</td>
<td></td>
<td>32841.40</td>
</tr>
</tbody>
</table>

*Note. Sex and age did not explain any additional variance after the final significant model and are not presented in the table. Values in this table represent Group mean centered variables (for face-to-face social interaction) and grand mean center predictors (for the LSAS and AQ).*

* = \( p < .05 \)  ** = \( p < .01 \)  *** = \( p < .001 \)
Discussion

Our most interesting finding was that an increase in social anxiety predicted a decrease in NA once face-to-face social interactions were accounted for. Previous research shows that socially anxious clinical groups tend to be more sensitive to social interactions compared to non-clinical groups (Hur et al., 2020). Hur et al. examined young adults with varying levels of social anxiety and found that individuals with heightened social anxiety were more likely to spend time alone, less time with close others, had fewer social networks, and increased NA. However, time with close others served as a buffer against NA, and time with acquaintances did not make a significant difference (Hur et al., 2020). The Hur et al. study supported our findings showing that increases in feeling connected in face-to-face interactions (i.e., not spending time alone) attenuated NA for socially anxious individuals. It should be noted that our study did not differentiate whether face-to-face interactions occurred with close others or acquaintances. Nonetheless, time with others (regardless with who) seemed to have reduced overall NA among individuals with higher social anxiety. The number of face-to-face interactions did not significantly predict NA in our sample when social anxiety was not accounted for. Our findings demonstrated that a model including face-to-face interaction and LSAS social anxiety provided a more accurate explanation of changes in NA outcomes.

We also found that autism traits did not increase predictive value in our model. Thus, autism traits would not help explain why individuals from our sample experienced changes in NA when face-to-face interactions and social anxiety were accounted for. This was not surprising given that anxiety tends to drive satisfaction in social interactions, not the autism traits themselves. Yet, it provides further support that social challenges which commonly occur in autism do not increase the likelihood for the individual experiencing changes in NA, rather it
may be driven by factors related to internalized emotions (e.g., anxiety and depression) and contextual influences. We were not able to directly measure coping strategies such as masking or camouflaging—these strategies may contribute to some level of social anxiety and NA and are likely influenced by face-to-face interactions. Future studies should examine these and consider other social awareness skills (e.g., Theory of Mind) when examining the relationship between types of interactions and affect outcomes. Additionally, the double-empathy problem acknowledges that lack of understanding from neurotypical individuals may dampen social experiences for autistic individuals and is worth exploring in relation to types of social interactions and affect. Altogether, our findings show that treatment addressing NA and emotion regulation should consider the interplay between type of social interaction and anxiety.

The model did not improve when adding age and sex covariates. One reason for this may be due to the homogeneity in group/individual characteristics. Most of our participants were female and similar in age (all were young adults). This presents a limitation in our sample as it impacts the generalizability of our study. However, our sample also reflected a population that often gets overlooked in autism research considering how autism is often missed in females compared to males (male-to-female diagnostic ratio is 3:1; Loomes et al., 2017).

Limitations

A limitation to our methods for assessing suicidal ideation includes the use of “percentage of suicidality in the past 12 hours” variable. This may not be the best predictor of suicidality considering Joiner’s Interpersonal Theory of Suicide (Joiner, 2005; Ringer & Anestis, 2017). Another limitation that would impact the generalizability of the results involves the lack of racial representation of non-white samples. Limitations regarding a homogeneous sample can be addressed by replicating the study using a larger sample size and more balanced ethnic
subsamples. Additionally, increasing sample size would improve overall statistical power, which would boost confidence in the predictive ability of our model (Maas & Hox, 2005; Scherbaum & Ferreter, 2009). It should also be noted that we dealt with missing data in our sample. As stated in the results section of the paper, missing data likely did not present a major issue in our analysis because shared variance was nested in hierarchical levels of the data and we were able to work with the data that we did have for each individual at a different time points (Heck et al., 2013).

**Future Directions**

It would be interesting to compare individuals who have different levels of NA to identify the extent that social interactions and social anxiety play into effect outcomes. Future research with this data set can also look into digital interactions and positive affect outcomes. Studying positive affect is crucial if we want to draw conclusions about emotion regulation strategies and to have a better understanding about the effects of types of interaction. Research examining digital interactions may reveal that this mode of interaction attenuates social pressures and stress or may negatively impact positive affect if the individual prefers face-to-face contact. On that note, it would be interesting to see the mediating effects that social anxiety and autism traits have on type of interaction and affect. For example, social anxiety may have a mediating effect on frequency of digital interactions and resulting positive affect. A key strength from this study was the use of EMA data to measure the effect of daily interactions and capture changes in mood. Future research assessing types of interactions and moods/affect should also incorporate daily or momentary data.

**Conclusion**
The aim of this study was to examine how types of interactions impact overall NA using a sample of young adults who are susceptible to social stressors. We particularly looked into face-to-face interactions due to the less controlled nature of the interaction and reliance on varying social and non-verbal cues. We also specifically looked into NA because of its connection to mental health risks and mood disorders. Use of EMA surveys were a strength in our methods and maximized our confidence that our data had high ecological validity. We used multilevel modeling to examine whether social anxiety and autism traits can help predict the relationship between face-to-face interaction and NA. Our findings support previous literature indicating that social anxiety helps predict NA and can impact the quality of face-to-face interaction. These findings also highlight that autism traits do not predict NA after controlling for social anxiety, and that social interventions should take internalized emotions into consideration to improve overall functioning and moods. More research is needed in identifying how types of interactions and social difficulties impact emotion regulation.


Heck, R.H., Thomas, S.L., & Tabata, L.N. (2013). *Multilevel and longitudinal modeling with*


Developmental Disorders, 50(8), 2832-2851.
https://doi.org/10.1007/s10803-020-04391-w

https://doi.org/10.1159/000414022

https://doi.org/10.1177/0706743716640757

https://doi.org/10.1016/j.jaac.2017.03.013


https://doi.org/10.1016/S0887-6185(02)00134-2


https://doi.org/10.1111/sltb.12367

https://doi.org/10.1016/j.janxdis.2016.05.008


