

EXAMINING THE RELATIONSHIP BETWEEN LONELINESS AND TRAUMA
THROUGH ECOLOGICAL MOMENTARY ASSESSMENT

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by

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San Francisco, California

January 2018

CERTIFICATION OF APPROVAL

I certify that I have read *Examining the Relationship Between Loneliness and Trauma through Ecological Momentary Assessment* by Rachel Melissa Gonzalez, and that in my opinion this work meets the criteria for approving a thesis submitted in partial fulfillment of the requirement for the degree Master of Arts in Psychology: Mind, Brain, and Behavior at San Francisco State University.



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EXAMINING THE RELATIONSHIP BETWEEN LONELINESS AND TRAUMA
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Loneliness and trauma are more common in college student populations than previously thought. Research indicates that experiencing traumatic events may make one more susceptible to feelings of loneliness, and this can lead to severely negative psychological states. This study used ecological momentary assessment (EMA) to study feelings of loneliness over the course of one week in a sample of students at San Francisco State University ($n = 19$). Trauma history was also assessed for each student with self-report questionnaires. Ultimately, we found that history of trauma did not significantly impact the cycle of loneliness, although childhood trauma was trending as a moderator.

I certify that the Abstract is a correct representation of the content of this thesis.



Chair, Thesis Committee

12/19/18
Date

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Recent research indicates that the overwhelming majority of college students have experienced at least one potentially traumatic event during their lifetime. In fact, some studies show that rates of posttraumatic stress disorder (PTSD) are higher in college students than they are in the general population (Read, Ouimette, White, Colder, & Farrow, 2011). Importantly, loneliness may be plaguing college students at higher rates than before, and people with a history of trauma are more likely to have difficulty coping with loneliness. People who have experienced traumatic events often experience difficulty connecting with others socially, which can increase the likelihood of depression, anxiety, and other psychological disorders (Briere & Scott, 2015). Thus, we aim to explore the relationship between loneliness and trauma history in a group of college students by tracking feelings of loneliness in real time over the course of one week. By utilizing ecological momentary assessment, which prompts participants multiple times over the course of the day, we hope to capture fluctuations in loneliness and related mood states throughout the week.

Loneliness is a commonly experienced phenomenon which, if not properly addressed, can result in surprisingly deleterious outcomes. Peplau and Perlman (1982) define loneliness as a perceived social isolation that occurs when one's social needs are unmet by the quality or quantity of one's social relationships. Current research shows that the quality of one's social connections is often more important than quantity in its ability to impact psychological well-being (Hyland et al., 2018). Thus, while it may be easy to

conflate loneliness with objective aloneness, the perceived aspect of loneliness is the most crucial factor that can impact one's life satisfaction.

While feelings of loneliness often lead to physical social isolation, people can still experience loneliness even if they are surrounded by others. Previous research has shown that feeling like one matters to others is a robust predictor of loneliness; in fact, a recent study revealed mattering to others was a more significant predictor of loneliness than personality traits and social phobia (Flett, Goldstein, Pechenkov, Nepon, & Wekerle, 2016). Loneliness also seems to impact certain populations more frequently. Recent studies indicate that loneliness across the lifespan follows a U-shaped distribution, with severe loneliness being most common during adolescence/early adulthood and old age (Lasgaard, Friis, & Shevlin, 2016). For this reason, it is crucial to study the severity of loneliness in college populations.

Importantly, lack of close, intimate relationships can result in various negative psychological and physical states. In past studies examining the impact of chronic loneliness, this social deficit has been linked to psychosis (DeNiro, 1995), suicidality (Goldsmith, Pellmar, Kleinman, & Bunney, 2002), depressive symptoms (Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006), cardiovascular health risk (Caspi, Harrington, Moffitt, Milne, & Poulton, 2006), and early mortality (Seeman, 2000). Older adults, a demographic that often experiences feelings of loneliness, is at risk for decreased cognitive capabilities and increased susceptibility to dementia due to lack of social connections (Gow, Pattie, Whiteman, Whalley, & Deary, 2007). Additionally,

loneliness has been considered an early warning sign of mental health disturbances (Solomon, Mikulincer, & Hobfoll, 1986), so understanding the driving mechanisms of loneliness is an important step toward creating preventative measures for chronic loneliness.

The Socio-cognitive Model of Loneliness

The socio-cognitive model of loneliness proposed by Cacioppo and Hawkley (2009) identifies three key mechanisms of loneliness: aloneness, social interaction quality, and hypervigilance for social threat. This model describes a cycle of loneliness in which people who experience social isolation feel unsafe in social environments and develop a hypervigilance for social threat, putting them on alert for negative social interactions. They form cognitive biases about the social world being an unsafe place, and unintentionally allow this perception to negatively impact their interactions with others (Cacioppo & Hawkley, 2005). This process leads to decreased satisfaction from social interactions, resulting in a self-fulfilling prophecy where the lonely individual continues to socially withdraw from others (Cacioppo & Hawkley, 2009). While the literature on aloneness as a driver of loneliness is mixed, there is conclusive evidence that interaction quality and hypervigilance for social threat are the primary mechanisms propelling loneliness.

Aloneness

While aloneness may seem synonymous with loneliness, aloneness refers to objective social isolation from others, or being by oneself. Everyone experiences some

amount of solitude over the course of their day, and this can be either a positive or negative experience. For example, in an ESM study of adolescents, Larson and Csikszentmihalyi (1978) found that participants felt more lonely, less happy, and less alert when they were alone compared to when they were spending time with others. With ESM, they demonstrated that participants' moods dipped once they were alone, confirming that aloneness was a catalyst for negative mood. However, this study also found that adolescents who spent about one-third of their time alone were actually the most well-adjusted (Larson and Csikszentmihalyi, 1978). One major critique of this research is that only high-arousal emotional states were recorded (e.g. sociable, excited, active), whereas the known positive effects of aloneness are typically low-arousal emotional states (e.g. relaxation, calmness). Past research has identified different types of solitude, many of which have positive connotations, such as associations with inner peace and self-discovery (Long, Seburn, Averill, & More, 2003). Recent studies have shown that while being alone does decrease high-arousal positive affect, it also decreases high-arousal negative affect, such as anger and anxiety. Additionally, when participants chose to be alone, solitude was associated with feelings of relaxation and reduced stress (Nguyen, Ryan, & Deci, 2018).

Due to the sample in the present study, we do not anticipate that aloneness will be associated with loneliness. College students tend to spend a small portion of their time alone since they are often on campus and are more likely to have roommates than older adults, so it seems more likely that they would benefit from solitude, experiencing

reduced stress and increased self-reflection during these times. Thus, we have eliminated aloneness from our analyses and chosen to focus on the other primary drivers of loneliness proposed by Cacioppo and Hawkley's socio-cognitive model.

Social Interaction Quality

Negative social experiences are likely to maintain a cycle of loneliness for those suffering from chronic loneliness. In a daily diary study of older adults, negative social exchanges were associated with greater feelings of loneliness, and positive social exchanges were associated with less feelings of loneliness. Additionally, even if negative exchanges occurred less than positive exchanges, negative interactions showed a more consistent impact on daily mood (Rook, 2001). Similarly, in an experimental study with adolescents, Vanhalst and colleagues (2015) found that participants exhibiting symptoms of chronic loneliness showed less enthusiasm when presented with vignettes about potential social inclusion situations and expressed more extreme negative emotions when presented with potential social exclusion situations. Thus, negative interactions fuel one's cognitive biases to perpetuate the cycle of loneliness.

Hypervigilance for Social Threat

Hypervigilance for social threat is an early stage in the loneliness cycle and can impact how one chooses to pursue social relationships (Hawkley & Cacioppo, 2010). People with chronic loneliness are often on alert for negative interactions, and this expectation can alter the course of any social situation (Cacioppo & Hawkley, 2009). Research shows that lonely individuals may have a prevention-focused interaction style,

meaning their social behavior is vigilant and cautious, which is primarily aimed at avoiding negative interactions. This is in contrast with a promotion-focused interaction style, in which the person is open-minded and strives for positive interaction outcomes (Lucas, Knowles, Gardner, Molden, & Jefferis, 2010). Thus, people who are hypervigilant to negative social situations may interact with others in a way that diminishes the quality of the interaction, leading to the self-fulfilling prophecy of social isolation that is proposed by the socio-cognitive model of loneliness (Newall et al., 2009).

Trauma

Loneliness can be particularly detrimental to certain groups, including people who have experienced traumatic events. Symptoms of posttraumatic stress disorder (PTSD) like emotional numbing and detachment from others encourage loneliness, which can exacerbate trauma symptoms and hinder positive growth after a traumatic event (American Psychiatric Association, 2013; Zeligman, Bialo, Brack, & Kearney, 2017). Additionally, the negative psychological outcomes of trauma are similar to those associated with loneliness. Depression, suicidality, and anxiety can impact people who are unable to effectively cope with traumatic events (Briere & Scott, 2015). Since trauma is a possible antecedent of loneliness, it is important to understand how experiencing traumatic events may ultimately lead to social isolation.

Experiencing a traumatic event affects an individual on a psychological, biological, and social level. Traumatic events are often life-threatening or extremely stressful, but can range anywhere from physical abuse to natural disasters to sudden death

of a loved one. Categorizing an event as traumatic is based on the subjective assessment from the person who experienced the event; typically, this assessment is related to how threatened or helpless one feels during the event (van der Kolk, McFarlane, & Weisaeth, 2007).

It is important to recognize that trauma is interpersonally situated, meaning that two people can experience the same potentially traumatic event and react to it in entirely different ways. For those who study trauma, the term *potential lifetime traumatic events (PLTE)* is used to indicate that objectively traumatic events, such as combat exposure or sexual abuse, may cause psychological distress depending on the value assigned to that event. However, this line of research also recognizes that some people may not be negatively impacted by these events (van der Velden, Pijnappel, & van der Meulen, 2017).

Due to the complex nature of trauma, this study chose to only assess the presence of PLTE for each participant. Thus, we were unable to capture the value assigned to the event or importance of the event for each person in our sample. Additionally, we chose to measure trauma on a spectrum as opposed to splitting participants into high trauma and low trauma groups. This method is more ecologically sound and was recommended by clinicians consulted for the study.

Trauma and Ecological Momentary Assessment

While trauma, broadly speaking, has not been studied with EMA, a recent review examined studies that used EMA/ESM to track posttraumatic stress symptoms (PTSS)

over time (Chun, 2016). Pilot studies have shown that EMA is a feasible method for studying PTSS and is not distressing to participants; in fact, they often found that this method helped participants gain insight about triggers for their symptoms (Johnson et al., 2002; Price et al., 2014). Many EMA studies indicate that retrospective reports of PTSS are far less reliable – for example, one study found that daily EMA revealed about 50% more reports of intrusive symptoms and flashbacks compared to surveys asking participants to think back on symptoms experienced over the past week (Priebe et al., 2013). EMA has also been used to show how people with PTSD and trauma cope with intrusive memories. A study by Kleim and colleagues (2013) used EMA to compare a PTSD group to a traumatized non-PTSD group and compare their experience with traumatic memories. Interestingly, they found that the traumatized non-PTSD group experienced only marginally less intrusive memories than the PTSD group, and suppression was the most common coping mechanism in both groups (Kleim et al., 2013). These results provide evidence for emotional and behavioral impacts on people who have experienced a traumatic event, regardless of PTSD diagnosis.

In some cases, participants have experienced lasting benefits from participating in an EMA study. Tarrier and colleagues (1999) found that by helping people with PTSD monitor their intrusive symptoms, about 10% of participants improved so much that they no longer met the criteria for PTSD. The participants' symptoms prior to the study were chronic, and at long term follow-ups (3 months and 12 months after the study) this improvement was still in effect (Tarrier et al., 1999). Thus, in addition to being a reliable

method for tracking intrusive trauma symptoms, regular check-ins can also allow for positive self-reflection in participants.

Based on this prior research, we are confident that EMA is the most efficient and effective way of addressing our research questions. Various symptoms of trauma and PTSD have been studied using EMA, and we seek to add to the literature by assessing how trauma may impact daily feelings of loneliness, which is less directly related to trauma but still a relevant phenomenon for this population.

Trauma and Loneliness

Previous research has indicated a strong connection between trauma history and trait loneliness, or stable feelings of loneliness over time (Rokach, 2001). In a sample of over 7,000 adults aged 16 years or older, adult loneliness was significantly predicted by childhood sexual or physical abuse, as well as a combination of the two. Additionally, loneliness mediated the relationship between childhood abuse and six adult psychiatric disorders, including depression, generalized anxiety disorder (GAD), and psychosis (Shevlin, McElroy, & Murphy, 2015). In a study examining the impact of trauma on incarcerated populations, sexual trauma and crime-related trauma were associated with loneliness, and history of any type of trauma was associated with lower perceived social support (Kao et al., 2014). There is consistent support in the field that experiences of trauma are related to diminished social connections in one way or another.

Research has also demonstrated that a higher number of PLTE increase the chances for higher levels of loneliness, especially when the events occur during

childhood and early adulthood. In a study of middle-aged and older adults, PLTE experienced earlier in life (ages 0-30) were more strongly associated with feelings of loneliness than PLTE experienced later in life (Palgi, Shrira, Ben-Ezra, Shiovitz, & Ayalon, 2012). Additionally, Clapp and Beck (2009) found that people with a history of childhood physical and/or sexual abuse experienced lower levels of social support compared to those without this trauma history.

Furthermore, a review of adult coping strategies found that social isolation and low interest in social support seeking was common for women who experienced childhood sexual abuse (Walsh, Fortier, & DiLillo, 2010). A study by Evans, Steel, and DeLillo (2013) found that an increase in perceived social support from friends predicted a decrease in trauma symptoms for men and women who experienced childhood abuse and maltreatment. Childhood trauma has also been shown to impact physical health later in life; a previous study revealed that pulse pressure was significantly predicted by early experiences of trauma, and this relationship was moderated by loneliness (Norman, Hawkey, Ball, Berntson, & Cacioppo, 2013). Thus, childhood trauma can have a lasting impact on an individual, particularly when loneliness and lack of social support are also present.

Early childhood trauma has been shown to impact feelings of loneliness even earlier than adulthood. A study by Murphy, Murphy, and Shevlin (2015) found that adolescents who reported high loneliness also reported early memories of childhood threat and bullying from their peers. These same lonely adolescents also felt that they

were of a lower social rank than their peers, indicating that loneliness and trauma can deeply impact one's confidence and sense of self (Murphy, Murphy, & Shevlin, 2015). Early experiences of trauma can set a precedent in childhood or adolescence that initiates a chronic cycle of loneliness, making it difficult to find and maintain social connections later in life.

Loneliness is relatively stable over time, so feelings of loneliness in adolescence will likely transfer into adulthood if they are not properly addressed in a therapeutic context. For instance, in a sample of 1,772 U.S. adults from ages 18-70, trauma experienced during childhood and adulthood was positively correlated with major depressive disorder and generalized anxiety disorder for those experiencing feelings of loneliness (Hyland, et al., 2018). Findings from a recent meta-analysis indicate that loneliness is a particularly strong predictor of traumatic stress symptoms for those who have been exposed to a traumatic event (Brewin et al., 2000). Thus, adults who have not developed strong social support networks will be more susceptible to PTSD and other mental health problems following a difficult or traumatic life event.

The methods commonly used to study loneliness and its relationship with trauma have a number of limitations. First, there is a considerable amount of variation in loneliness measurements, making it difficult to empirically compare and connect loneliness research studies (Hyland et al., 2018). While many studies use the UCLA Loneliness Scale, the gold standard measure in loneliness research (also used in the present study), other studies measure loneliness with shortened scales or even one

question from a longer scale to operationalize this construct. Additionally, previous methods focus on measuring trait loneliness and do not attempt to capture state loneliness, or feelings of loneliness on a daily basis. By using ecological momentary assessment, we can track loneliness in real time over the course of one week to determine how trauma history impacts feelings of loneliness on a moment-to-moment basis in daily life.

The Present Study

The goal of the present study is to better understand the relationship between history of trauma and feelings of loneliness in daily life. We have generated multiple hypotheses about our expected findings. We predict that (i) people who experience lower interaction quality will experience more loneliness; (ii) people who are more hypervigilant to social threat will experience more loneliness; and (iii) trauma history will moderate the relationship between hypervigilance for social threat and feelings of loneliness in daily life.

Methods

Participants

Participants for this study were students recruited from San Francisco State University ($n = 19$). Students were recruited through announcements made in psychology courses and flyers posted around the San Francisco State University campus. For this study, students had the option of receiving course credit (only applicable to students in specific psychology courses) or cash payment for their participation. To qualify for the

study, participants had to be at least 18 years old and primarily use an Android smartphone. Participants in this study ranged from 19 to 47 years old ($M = 25.74$, $SD = 6.75$) and lived in the San Francisco Bay Area.

Materials and Apparatus

At the beginning of the study, each participant reviewed the consent form with the researcher and asked any questions they had about the study procedures at that time. The participant then completed psychological questionnaires on a desktop computer in the laboratory. Finally, the researcher helped the participant download the Ethica Health application to their phone and trained the participant in its use. The researcher also demonstrated how to use the application's companion website, which allows the participant to track their own participation throughout the week.

Over the course of one week, participants were prompted by the Ethica Health application to complete short surveys four times each day. Participants were required to complete these surveys within 30 minutes of receiving the prompt. Surveys were sent to participants pseudorandomly between the hours of 9:00 AM and 12:00 AM (midnight). In addition to collecting surveys, this application also recorded various streams including ambient audio, GPS, Bluetooth, and accelerometer. This data was not analyzed for the present study.

At the end of the week, participants returned to the laboratory to complete a final round of psychological questionnaires: the UCLA Loneliness Scale (Russell, 1996); the Trauma History Questionnaire (THQ; Green, 1996); and the Adverse Childhood

Experience Questionnaire (ACE; Felitti et al., 1998). Participants removed the Ethica Health application from their phone with the researcher and completed a debriefing about the study. Participants also received payment and course credit at this time.

Procedure

Participants began the study by coming to the laboratory for a one-hour session. After signing the consent form, participants were seated in front of a computer to complete a set of psychological questionnaires. During this session, participants completed the following questionnaires: the UCLA Loneliness Scale; the 21-item Depression, Anxiety, and Stress Scale (DASS-21; Antony, Bieling, Cox, Enns, & Swinson, 1998); the Physical and Social Anhedonia Scales (Chapman, Chapman, & Raulin, 1976); the Role and Social Functioning Scales (Birchwood, Smith, Cochrane, Wetton, & Copestake, 1990; Goodman, Sewell, Cooley, & Leavitt, 1993); the Apathy Evaluation Scale (Marin, Biedrzycki, & Firinciogullari, 2011); and the Anticipatory and Consummatory Interpersonal Pleasure Scales (Gooding & Pflum, 2014). The questionnaires ended with a demographic questionnaire before completing the remaining tasks with the researcher.

Next, the researcher instructed the participant to open the Google Play store on their cell phone and download the Ethica Health application. Once the app was downloaded, participants made an account through the application, which includes an email and password. Once this step was completed, a screen appeared where the researcher entered the participant's individual ID number that was used for the study. The

researcher also recorded a baseline of the participant's voice by asking them to read a paragraph from the consent form. Once this information was submitted, the researcher showed the participant how to use the application and explained what the surveys would look like during the week. Additionally, the researcher showed the participant how to log in to the Ethica website, which allowed them to monitor their progress throughout the week. This also allowed participants to review the ambient audio data collected during the study and delete any audio recordings that they did not want to be included in final data analysis.

After the first lab visit, participants completed one week of ecological momentary assessment (EMA). This method uses repeated sampling of participants' experiences and behaviors in real time in their regular day-to-day environment. EMA has numerous benefits for clinical research in particular. First, it minimizes recall bias since information about the participants' emotions and thoughts surrounding a particular situation are recorded in the moment. Second, it maximizes ecological validity by capturing data in a participant's real-world environment as opposed to in a laboratory. Additionally, this method allows researchers to study how behavior is influenced in real life, which is more reliable than behaviors that are induced in a laboratory setting. Therefore, we have chosen to use EMA to accurately and reliably track feelings of loneliness over time.

Throughout the course of the week, participants answered four survey prompts between the hours of 9:00 am to 12:00 am (midnight). The surveys began by asking participants about their basic emotional state, where they are, whether they are alone or

with others, and their desire to interact with others at that moment. Next, the surveys asked a series of questions to assess state loneliness, or loneliness in the moment. These questions included (1) how lonely do you feel right now? (2) how left out do you feel right now? (3) how connected do you feel with the people around you? and (4) do you feel that there are people you can talk to right now? After completing this section, the surveys asked whether the participant had an interaction in the past 3 hours. If participants answered yes, they were asked how intimate the interaction was, how much personal information was disclosed during this interaction, and how criticized or rejected they felt during this interaction. These questions were meant to assess interaction quality for each participant. However, if participants did not have an interaction to report, they answered a series of questions about how they spent their time instead, and whether this time was satisfying, enjoyable, and productive. At the end of the survey, participants were asked how much criticism and rejection they expected from their next interaction; this question was used to assess hypervigilance for social threat.

At the end of the week, participants returned to the lab to complete the final portion of the study. Participants completed the UCLA Loneliness Scale for a second time, as well as two new measures to assess trauma history: the Adverse Childhood Experience Questionnaire and the Trauma History Questionnaire. The ACE asks participants about past experiences of trauma in the first 18 years of life, whereas the THQ asks participants about traumatic experiences at any point in their lifetime. Once these measures were completed, participants uninstalled the Ethica application from their

phones, completed a debriefing with the researcher, and received compensation for the study.

Data Analysis

We used HLM version 7.3 to analyze data for this study. Loneliness was entered as the outcome variable, and was measured by a loneliness sum score from the EMA data collected. Interaction quality and hypervigilance for social threat were entered as level one predictors in our model, also measured by scores from the EMA data. Thus, our level 1 model was as follows:

$$LONELINE_{ii} = \pi_{0i} + \pi_{1i}*(INTERQUA_{ii}) + \pi_{2i}*(HYPERVIG_{ii}) + e_{ii}$$

Next, we entered trauma history as the level 2 predictor in our model. We used the final ACE and THQ scores for each participant as our trauma history measures. Our level 2 model is shown below:

$$\pi_{0i} = \beta_{00} + r_{0i}$$

$$\pi_{1i} = \beta_{10}$$

$$\pi_{2i} = \beta_{20} + \beta_{21}*(ACE_i) + \beta_{22}*(THQ_i) + r_{2i}$$

Finally, this was our mixed model with all of the predictors:

$$\begin{aligned} LONELINE_{ii} = & \beta_{00} \\ & + \beta_{10}*INTERQUA_{ii} \\ & + \beta_{20}*HYPERVIG_{ii} + \beta_{21}*ACE_i*HYPERVIG_{ii} + \beta_{22}*THQ_i*HYPERVIG_{ii} \\ & + r_{0i} + r_{2i}*HYPERVIG_{ii} + e_{ii} \end{aligned}$$

The mixed model allowed us to test the impact of trauma history on the relationship between hypervigilance for social threat and daily loneliness.

Results

In total, 21 participants completed the study. Two participants were dropped from analyses for not completing enough survey prompts during the week, leaving us with our final sample ($n = 19$). Regarding demographics for the final sample, 63% of the participants were female ($n = 12$) and the average age of the sample was 25.74 ($SD = 6.75$). Additionally, we recruited a rather diverse sample: 32% identified as Mexican American ($n = 6$), 26% identified as Other Latino ($n = 5$), 21% identified as Multi-Racial ($n = 4$), 16% identified as Caucasian ($n = 3$), and .05% identified as Other Asian ($n = 1$).

Trait Measures

Scores were computed for the ACE and the THQ separately; participants received one point per question on each scale, and these points were added to compute 2 total scores. For ACE scores, the median score was 2 ($SD = 2.47$), with scores ranging from 0-7 (10 was the maximum possible score). For THQ scores, the median score was 4 ($SD = 2.91$), with scores ranging from 0-9 (24 was the maximum possible score). Only one participant in the sample scored 0 on both scales. Thus, almost everyone in the sample had experienced a past traumatic event, and many people in this sample had experienced multiple adverse events.

Scores for the UCLA Loneliness Scale are on a 0-60 scale; participants received 0 points for a response of “Never,” 1 point for a response of “Rarely,” 2 points for a

response of “Sometimes,” and 3 points for a response of “Often.” Scores in this sample ranged from 20-46, with a median score of 33 ($SD = 5.79$). Therefore, while many students in this sample fell somewhere in the middle on the loneliness scale, there were also a number of participants who reported significant feelings of loneliness.

EMA Analyses

Hierarchical linear modeling (HLM) was used to statistically analyze the nested data structure, since EMA produces multiple data points throughout the week for each participant. Of specific interest was the relationship between loneliness (level-1 outcome variable) and interaction quality and hypervigilance for social threat (level-1 predictor variables), as well as trauma history (level-2 predictor variable). A random intercepts and slopes model was used to test all predictor variables in one model.

The intercept-only model revealed an ICC of .37. Thus, 37% of the variance in daily loneliness is between-subjects and 63% of the variance in daily loneliness is within-subjects. We chose to add two predictor variables at level 1, interaction quality and hypervigilance for social threat, due to their equal importance as part of the loneliness cycle. The regression coefficient relating interaction quality to loneliness was negative and statistically significant at $p < 0.05$ ($b = -0.06, p = .015$). This means that interaction quality and loneliness operate inversely; for example, as interaction quality increased during the week, feelings of loneliness decreased. This indicates that positive interactions were crucial for preventing loneliness throughout the day. However, the regression coefficient relating hypervigilance for social threat to loneliness was positive and not

statistically significant ($b = 0.48, p = 0.223$). Thus, hypervigilance for social threat did not have an impact on loneliness as we had anticipated. Robust standard errors were not used when assessing final values because the data set did not meet the appropriate criteria (too few level 2 units).

Next, the level 2 predictor, trauma history, was added to the model. Since there was not a methodologically sound way to combine scores from the separate measures, scores from the ACE and the THQ were assessed separately. Our analyses revealed that when ACE scores were added to the model, the relationship between loneliness and hypervigilance for social threat was trending in the negative direction ($b = -0.21, p = .054$), whereas the THQ revealed no significant relationship ($b = 0.07, p = 0.338$). Thus, while traumatic events across the lifespan did not necessarily have an impact on the relationship between hypervigilance for social threat and daily experiences of loneliness, childhood trauma in particular did seem to influence this relationship.

Discussion

In conclusion, we found partial support for our hypotheses, as well as a promising trend. We found that interaction quality was significantly related to feelings of loneliness; people who were less satisfied with their social interactions also felt more loneliness throughout the day. This supports the theory that people who are particularly lonely experience more negative interactions compared to people who tend to feel less lonely. However, we did not find a significant association between hypervigilance for social threat and loneliness as we had anticipated. This may be due to a small sample size, but it

could also indicate that our survey questions did not appropriately capture hypervigilance for social threat in this sample.

Regarding our analyses including the trauma measures, we chose to assess the ACE and THQ scales separately, since the overlap of traumatic experiences between the two would make combining the scores ineffective. When THQ scores were added to the model, we did not find a significant relationship between loneliness and hypervigilance for social threat. Since the THQ covers a wide range of experiences across the lifespan, it may not have been the best measure for assessing trauma in this sample. For example, this scale asks about experiences that may or may not be traumatic depending on the context; when asked to specify the experience of seeing a dead body, more than one participant reported seeing a cadaver as part of an academic experience, which is unlikely to be traumatic.

Interestingly, when ACE scores were added to the model, the relationship between loneliness and hypervigilance for social threat showed a promising trend. However, this trend indicates a negative relationship, in which loneliness increases as hypervigilance for social threat decreases. This is the opposite of what we would expect, considering hypervigilance for social threat is typically positively associated with loneliness in the literature, particularly in the socio-cognitive model of loneliness. Based on these results, we anticipate that with a larger sample size, this trend would become significant. Although, once again, this finding may be a product of the way hypervigilance for social threat was measured in this study, or the small sample size may

have created an atypical effect. However, it does seem to indicate that experiences of childhood trauma have a significant impact on loneliness compared to traumatic experiences later in life, which has already been suggested by previous research.

One of the concerns before conducting this study was that students would not report enough loneliness or experiences of trauma for us to conduct our analyses. However, we found that many students reported high rates of loneliness, and all but one participant reported the presence of at least one traumatic event, with some students reporting up to nine traumatic events. Thus, we did not find evidence of a self-presentation bias, as students appeared to report their experiences openly and honestly. Importantly, these results indicate that not only do many students experience significant feelings of loneliness, but also that experiences of trauma may be more common than previously thought.

Despite this study's promising findings, it was limited by small sample size, difficulty with recruitment, and time constraints. The study also faced challenges with some of the chosen methods and measures, which could be improved upon in future research. For instance, the reliance on self-report measures may have resulted in a reporting bias that impacted the results. Studies that include more objective assessments of loneliness and utilize experimenter evaluation may capture true experiences more effectively. For example, we did not examine the objective quality of one's interactions. Some people have consistent social interactions, but may be receiving ineffective social support from friends and family, which can still impact how they handle difficult life

events. Additionally, this study neglected to measure symptoms associated with traumatic events, and only focused on the objective experience of distressing events. The PLTE literature explains how everyone reacts to difficult events independently, so by only measuring the presence of an event, the study failed to capture each individual's value assigned to those events. We may have found a stronger connection to loneliness if we chose to measure PTSD symptoms or psychological distress related to the traumatic event instead.

In contrast to the way this study chose to measure loneliness, prior research has argued for a multidimensional approach to loneliness, making a distinction between social and emotional loneliness (Weiss, 1974). While social loneliness is linked to decreased social connections, emotional loneliness is related to deficits in one's existing close relationships (Dykstra & Fokkema, 2007). We did not measure satisfaction with social relationships at this level, so we do not know what type of loneliness was driving our results, which would be helpful for determining interventions for loneliness. Additionally, it appears that traumatic exposure during different times across the lifespan may be associated with different types of loneliness. For instance, a recent study found that childhood trauma was linked to emotional loneliness, but not social loneliness (Hyland, 2018). This may explain why we saw more of an impact with the ACE, which measures childhood trauma, compared to the THQ. Thus, addressing loneliness with a unidimensional approach, which may have been insufficient for identifying the

connection between loneliness and traumatic experiences, and could be a potential explanation for our lack of significant results.

Research indicates that the majority of college students have experienced PLTE (also evidenced by this study), so it is important to understand the risk factors for developing PTSD or other serious mental health problems as a result of trauma. Additionally, prevalence of PTSD symptoms is higher in college students than in the general population (Read et al., 2011). Similarly, there is evidence that loneliness may be a chronic condition for around 15-30% of the population (Heinrich & Gullone, 2006; Theeke, 2009), making it imperative to understand who is most affected by loneliness and how it can be remedied at an early age. College campuses that create a positive social atmosphere for students, such as allocating a budget for school events and social clubs/organizations, will likely see improvements in mental health among the student body. Additionally, colleges and universities should make it a mission to educate students about the negative impacts of trauma and loneliness, as well as the ways in which they are connected. For instance, at orientation for first year students, mental health professionals can suggest strategies for combating loneliness and provide resources for students who may be dealing with trauma. Since students do not always know where or how to ask for help, promoting mental health services early on in their college experience will make students more likely to use them. On a related note, counselors on college campuses who treat students experiencing severe loneliness should assess for past

traumatic experiences and the quality of their current social relationships to determine what may be causing the deficit in connection with their peers.

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Table 1. Fixed effects for the HLM model of loneliness and trauma.

Fixed Effect	Coefficient	Standard error	<i>t</i> -ratio	Approx. <i>d.f.</i>	<i>p</i> -value
For INTRCPT1, π_0					
INTRCPT2, β_{00}	4.868793	0.244231	19.935	18	<0.001
For INTERQUA slope, π_1					
INTRCPT2, β_{10}	-0.058802	0.024142	-2.436	363	0.015
For HYPERVIG slope, π_2					
INTRCPT2, β_{20}	0.481862	0.379838	1.269	16	0.223
ACE, β_{21}	-0.211972	0.102034	-2.077	16	0.054
THQ, β_{22}	0.074167	0.075017	0.989	16	0.338

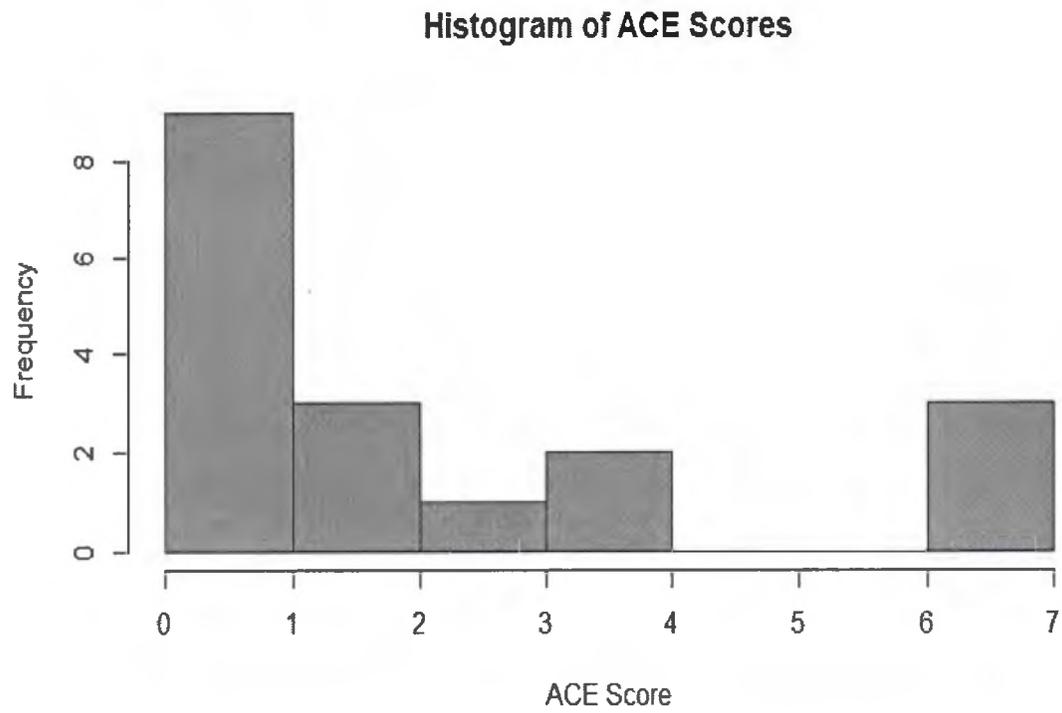


Figure 1. Distribution for Adverse Childhood Experience (ACE) scores ($n = 19$).

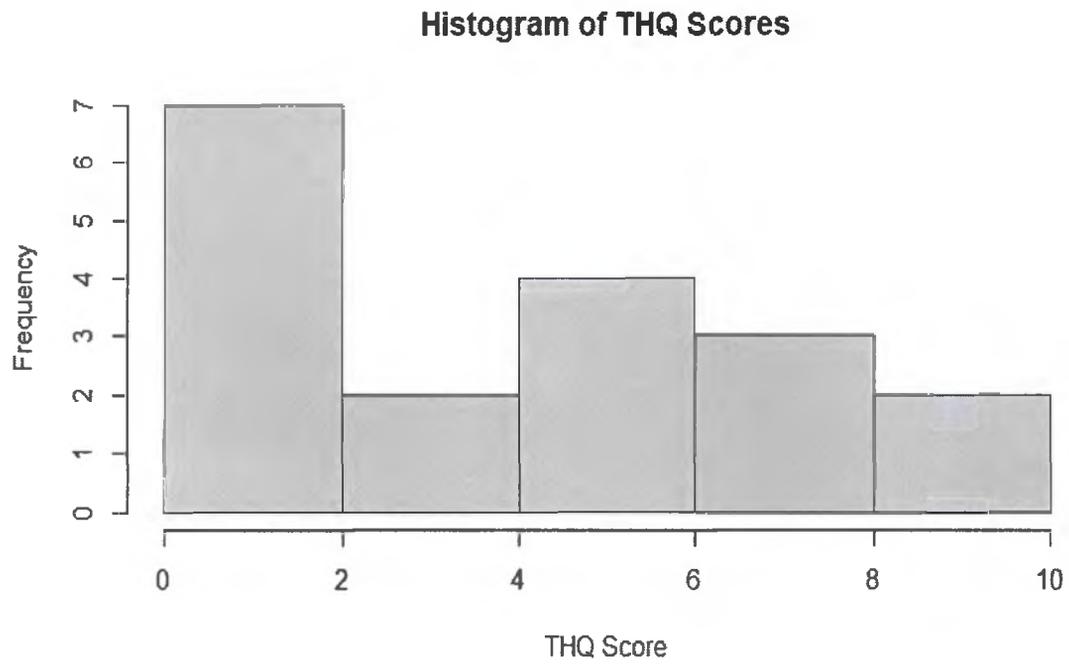


Figure 2. Distribution of Trauma History Questionnaire (THQ) scores ($n = 19$).

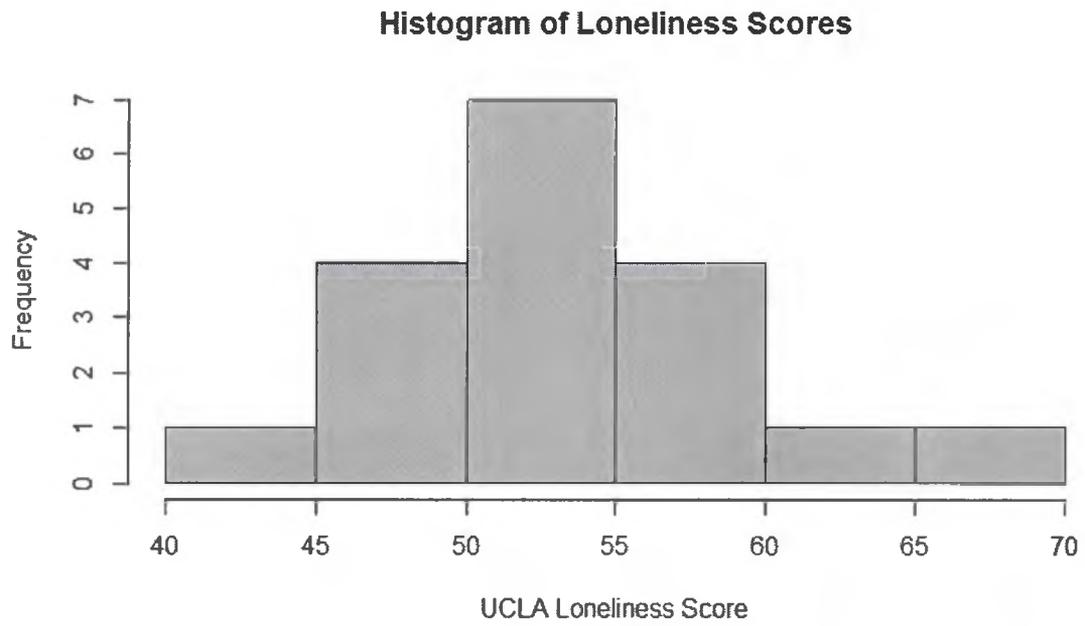


Figure 3. Distribution of UCLA Loneliness Scale scores ($n = 19$).