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Latent class analysis of loneliness and connectedness in US young adults during COVID-19

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Abstract

Objective: The coronavirus disease 2019 (COVID-19) pandemic in the United States has exacerbated a number of mental health conditions and problems related to prolonged social isolation. While COVID-19 has led to greater loneliness and a lack of social connectedness, little is known about who are the most affected and how they are impacted. Therefore, we performed a Latent Class Analysis using items from two scales – the UCLA Loneliness Scale and the Social Connectedness Scale – to characterize different experiences of loneliness and connectedness, examine their relationship with mental health and substance use symptoms, including depression, anxiety, drinking, and drug use.

Methods: Data were drawn from an anonymous one-time online survey examining the mental health of 1008 young adults (18–35 years old) during COVID-19. A latent class analysis (LCA) was conducted to observe and identify classes based on responses to loneliness and connectedness scale items, and to examine the existence of subgroups among this young adult population.

Results: We identified a 4-class model of loneliness and connectedness: (1) *Lonely and Disconnected* – highest probabilities in items of loneliness and disconnectedness, (2) *Moderately Lonely and Disconnected* – adaptive levels of some isolation and disconnection during COVID-19, (3) *Ambivalent Feelings* – displaying negative responses in particular to

negatively-worded items while simultaneously affirming positively worded items, and (4) *Connected and Not Lonely* – lowest probabilities in items of loneliness and disconnectedness.

Conclusion: Key findings include (1) the delineation of classes by levels of loneliness and connectedness showcasing differential mental health and substance use symptoms, (2) the utility of item-level evaluation with LCA in determining specific classes of people in need of outreach and intervention, and (3) the promise of social connection to bolster resilience in young adults.

KEYWORDS

COVID-19, latent class analysis, loneliness, mental health, social connectedness, substance use

1 | INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has exacerbated a number of mental health conditions and related problems (Galea et al., 2020; Volkow, 2020; Wang et al., 2020). The adverse psychological effects of the pandemic include posttraumatic stress disorder, anxiety, depression, and suicidal ideation (Murata et al., 2021; Rudenstine et al., 2021). The pandemic also has affected alcohol and cigarette consumption (Christie et al., 2021), coping-motivated drinking (Wardell et al., 2020), and initiation of or increase in substance use to cope with stress or emotions (McKnight-Eily et al., 2021), among others. In the face of "social distancing" recommendations, a loss of social relationships may be contributing to loneliness and a lack of social connectedness, heightening mental health symptomatology.

Social relationships, especially the absence or loss of relationships, play a critically important role in physical and mental health (Deindl et al., 2016; Hawkley & Cacioppo, 2010; Holt-Lunstad et al., 2010; Stanley, 2003; Wang et al., 2017). A lack of social connectedness, in particular, is a major risk factor for morbidity and mortality (Cacioppo & Cacioppo, 2014; Holt-Lunstad et al., 2015) due to increased risks for depression (Herbolsheimer et al., 2018; Leigh-Hunt et al., 2017), anxiety (Santini et al., 2020), suicide (Calati et al., 2018), dementia (Penninkilampi et al., 2018), and hazardous behaviors such as smoking and sedentary lifestyle, obesity, high blood pressure (Cacioppo et al., 2011), and diagnoses of chronic illnesses (Cantarero-Prieto et al., 2018). Social isolation can also lead to increased feelings of loneliness (Cacioppo et al., 2011), a dangerous epidemic in the United States (Murthy 2017). Loneliness is similarly associated with poor mental and physical health outcomes, such as depression, suicidality, substance abuse (Lamis et al., 2014), cognitive decline, and overall health and mortality (Hawkley & Cacioppo, 2010).

However, scholars often conflate a lack of social connectedness and loneliness when studying the absence or loss of social relationships as determinants of health (Holt-Lunstad et al., 2015; Satici et al., 2016). While decades of research have confirmed a linear relationship between levels of loneliness and adverse health outcomes (Hawkley & Cacioppo, 2010), we recognize that a comprehensive understanding of the problem needs to distinguish loneliness from a lack of social connectedness as leading health determinants (Holt-Lunstad et al., 2017). In this study, we employ a person-centered approach to investigate how loneliness and social connectedness during the COVID-19 pandemic are related to one another and how they collectively serve as a determinant of mental health and substance use behavior.

Even before the pandemic hit, one age group, in particular, demonstrated the highest prevalence of loneliness – young adults (Cigna International, 2018; Hawkley & Cacioppo, 2010; Murthy 2017). Now amidst the global pandemic,

studies of young adults have uncovered potentially elevated levels of loneliness, depression, anxiety, and substance use, (Rudenstine et al., 2021; Varma et al., 2021) and alarming low levels of social connectedness (Horigian et al., 2020). During the pandemic, social disconnectedness and perceived isolation were also shown to predict higher depression and anxiety symptoms (Santini et al., 2020), while individuals feeling more socially isolated had more severe drug use problems (Christie et al., 2021). Distinct experiences of loneliness and social connectedness could be linked to distinguishable groups with differential outcomes of these symptoms and behaviors. However, little is known about who are the most affected by high levels of loneliness and low levels of connectedness.

A complete understanding of the interplay but distinction between experiences of loneliness and connectedness requires looking beyond the mean loneliness and connectedness scale scores, which provide only broad variable-centered information. An assessment of the underlying latent structure of responses allows individuals to be divided into subgroups based on shared characteristics. Grouping individuals based on item response patterns can delineate subgroups with distinct experiences of loneliness and connectedness and may help to identify more dangerously disconnected groups of young adults. Latent Class Analysis (LCA) (McLachlan & Peel, 2004) – a latent variable modeling technique that identifies unobserved, conceptually mutually exclusive, and exhaustive subgroups of individuals within a population based on responses to a set of indicators – provides an alternative approach to understanding combinations of loneliness and connectedness clusters that exist across individuals' responses, which cannot be captured using the traditional summarized composite scores (Wetzel et al., 2016). In this study, we use an LCA approach to characterize different types of loneliness and connectedness experienced by young adults during COVID-19 as they reported symptomatology on the UCLA Loneliness Scale (UCLA) and the Social Connectedness Scale (SCS-15). We examine the relationship between class membership and other identifying factors and behaviors, to evaluate if those classified by high levels of loneliness and connectedness also demonstrate higher levels of depression, anxiety, and substance use during COVID-19. To our knowledge, no prior studies have been conducted using this approach to characterize young adult populations by responses to both loneliness and social connectedness together.

2 | METHODS

2.1 | Study sample

This study utilizes data from a survey of 1008 young adults (18–35 years old) recruited via a flyer and survey link posted to social media and networking sites, including Instagram, Facebook, LinkedIn, and Twitter, during the early months of the COVID-19 pandemic from April 22 to May 11, 2020 (Horigian et al., 2020). The flyer included the purpose of the study – "to gain an understanding of the psychosocial impacts of COVID-19 on young adults" – and the compensation of a $20 eGift card upon completion. The flyer was also distributed to US colleges and universities via department newsletters and student association Facebook pages. Participant consent was obtained electronically before beginning the survey. The study was approved by the University of Miami Institutional Review Board. The design of the study was presented in Horigian et al. (2020). Consenting participants were asked to complete a one-time, 126-item anonymous survey capturing mental health symptomatology with six validated self-report measures. Demographics, behaviors, and other covariates including age, gender, educational attainment, number of people living in the household, city and state of residence, and social media use were also collected. All participants who had completed the survey were included in analyses.

2.2 | Measures

The UCLA-Loneliness Scale (UCLA) (Russel et al., 1980) is a widely used questionnaire evaluating self-reported feelings of loneliness. The scale consists of 20 items on a 4-point Likert scale ranging from 1 (never) to 4 (often)

wherein the total score is obtained by summing all items, which ranges from 20 to 80. Nine of the positively worded items are reverse-coded. Higher scores are reflective of greater loneliness. The internal consistency was acceptable among this sample (Cronbach's alpha = 0.81). Following previous studies using the UCLA for latent class analysis, each item was transformed into a binary variable, where "never" and "rarely" were coded as 0, and "sometimes" and "often" were coded as 1 (Shevlin et al., 2014).

The Social Connectedness Scale-Revised (Lee et al., 2001), further extracted to a 15-item Social Connectedness Scale (SCS-15) (Lee et al., 2008), measures a psychological sense of belonging, or how individuals cognitively construe interpersonal closeness with others in their social world. SCS-15 items do not refer to feelings of *distress* about disconnection (which would encompass loneliness); rather, they refer to subjective feelings of connection/ disconnection, bordering objective feelings of social isolation. Higher scores are reflective of greater connectedness. The internal consistency was acceptable among this sample (Cronbach's alpha = 0.80). The SCS-15 uses a 6-point rating scale from 1 (strongly disagree) to 6 (strongly agree). Ten of the negatively worded items are reverse-coded. Each item was then transformed into a binary variable, where "Strongly disagree," "Disagree," and "Somewhat disagree" were coded as 0, and "Strongly agree," "Agree," and "Somewhat agree" were coded as 1.

In addition to the UCLA, SCS-15, and demographic and behavioral information, four scales captured mental health symptomology and behaviors. The Alcohol Use Disorder Identification Test (AUDIT) is a 10-item self-report questionnaire developed by the World Health Organization to identify individual alcohol consumption (Saunders et al., 1993). Participants rated items on a 5-point Likert scale, indicating amount (0–10 drinks or more) and frequency (never to daily or almost daily) of consumption, as well as an indication of problems caused by alcohol (yes or no). Items were summed to create a score ranging from 0 to 40, with scores of 1–7 indicating low-risk consumption, 8–15 indicating risky or hazardous drinking, and greater than 15 indicating high-risk drinking and alcohol dependence (Cronbach's alpha = 0.91).

The Drug Abuse Screening Test (DAST-10) is a self-report screening test that provides a quantitative index of the degree of consequences related to drug abuse (Skinner, 1982). Participants responded yes (1 point) or no (0 points) to 10 prompts and then items were summed to create a score ranging from 0 to 10. A score of 1–2 indicates low-level problems related to drugs, 3–5 indicates moderate problems, 6–8 indicates substantial problems, and 9–10 indicates severe problems (Cronbach's alpha = 0.92).

The Generalized Anxiety Disorder (GAD-7) is a 7-item self-report screening tool that assesses the presence and severity of Generalized Anxiety Disorder (Spitzer et al., 2006). Participants rated frequency of problems on a 4-point Likert scale ranging from 0 (not at all) to 3 (nearly every day), and items were summed to create a score ranging from 0 to 21, with scores of 5, 10, and 15 as thresholds indicating mild, moderate and severe anxiety, respectively (Cronbach's alpha = 0.80).

The Center for Epidemiologic Studies Depression scale (CES-D-10) is a 10 item self-report measure that assesses the frequency of symptoms of depression (Andresen et al., 1994). Participants rated symptoms on a 4-point scale from 0 (rare or none of the time) to 3 (most or almost all the time), and items were summed to create a score from 0 to 30, with higher scores representing greater depressive symptoms, and 10 or more indicating the presence of significant depressive symptoms (Cronbach's alpha = 0.75).

2.3 | Analysis

An LCA was conducted to observe and identify classes based on responses to the items in the UCLA and the SCS-15 in order to to examine the existence of subgroups of loneliness and connectedness among this young adult population. For the model evaluation (Wickrama et al., 2016), several fit indices were utilized, such as the Akaike Information Criterion (AIC) (Akaike, 1987), the Bayesian Information Criterion (BIC) (Schwartz, 1978), the sample size adjusted Bayesian Information Criterion (ssaBIC) (Sclove, 1987; lower value is preferred), entropy (≥0.70 is acceptable), and the Lo–Mendell–Rubin Likelihood Ratio Test (LMR-LRT; significant *p* value indicates the k class

model is better than k-1 class model). Additionally, we examined the estimated probabilities plot/plot interpretability, and sample size of each class (*n* >10%; Masyn, 2013). Classes with a sample size less than 10% may be indicative of a nonrepresentative biased sample (Masyn, 2013). Models with two to six classes were estimated using robust maximum likelihood (Yuan & Bentler, 2000).

A confirmatory factor analysis (CFA) was performed to verify whether responses to measures in this sample were consistent with currently understood constructs of loneliness and social connectedness. A 4-factor analytic model, including three previously identified factors in the UCLA ("Isolation," "Relational Connectedness," and "Collective Connectedness" in Hawkley et al., 2005) and the SCS-15 included as a single factor, as specified, and tested within the CFA framework. The LCA and CFA were conducted using Mplus 6.1 (Muthén & Muthén, 2018).

Using the most likely latent class membership to classify the individuals within the sample, descriptive statistics were computed for the age, gender, race/ethnicity, education, and household size breakdown within each class using SAS University Edition (SAS, 2015). A similar approach was used to compute the frequency of individuals by class scoring in each clinical cutoff range for all six scales: UCLA, SCS-15, GAD-7, CES-D-10, AUDIT, and DAST-10, as well as the mean scale score by class. Pairwise comparisons were performed to assess significant differences between all pairs of scale score means. Categories of both substance use scales, the AUDIT and DAST-10, were defined using the clinical cutoffs to identify individuals scoring less than 3 in both scales as "Safe," those scoring as 0 in one scale and but above 3 in the other as "Minor," and those scoring from 1 to 3 in both scales as "Serious." Individuals scoring greater than 3 in the AUDIT and from 3 to 5 in the DAST-10 or scoring greater than 2 in the DAST and from 4 to 12 in the AUDIT were identified as "Double Serious," and those scoring greater than 12 in the AUDIT and greater than a 5 in the DAST were identified as "Double Severe." Additional descriptive statistics were considered, such as the proportion who responded that their symptoms had increased, decreased, or remained the same since COVID-19 was declared a pandemic, as well as the proportion who responded that various social networking behaviors had increased, decreased, or remained the same.

3 | RESULTS

Latent Class Analysis Model fit was assessed for models with 2–7 classes (see model fit in Table 1). Multiple fit statistics indicated that a 4-class model best fit the data. The BIC score (40560.13) and sample-size Adjusted BIC score (40105.95) were lower in the 4-class model than the 2 and 3 class. Selection of the final model also took into consideration plot interpretability, class distinction, and estimated sample sizes; the 5-class and 6-class models each had subgroups with only 2.5%. Furthermore, the 4-class model presented a solution with a logical substantive interpretation.

Characterized by their responses to 35 items of loneliness and social connectedness, groups of individuals identified in the 4-class model were labeled as (1) *Lonely and Disconnected* (*n* = 63; 6.3%) – highest probabilities in items of loneliness and disconnectedness, (2) *Moderately Lonely and Disconnected* (*n* = 575; 57.0%) – adaptive levels of some isolation and disconnection during COVID-19, (3) *Ambivalent Feelings* (*n* = 198; 19.6%) – displaying negative responses in particular to negatively-worded items while simultaneously affirming positively worded items, and (4) *Connected and Not Lonely* (*n* = 172; 17.1%) – lowest probabilities in items of loneliness and disconnectedness. While each class was distinguished by patterns in answers to scale items, response time analysis between the four classes indicated no significant differences in total survey duration. Initial confirmatory factor analysis of our scales also indicated acceptable response patterns across our participants. Figure 1 shows the probabilities of endorsing each item by most-likely class membership for this 4-class solution based on the UCLA and SCS-15 items. As higher UCLA probabilities indicate higher loneliness, the SCS-15 item probabilities were all subtracted from 1 so higher probabilities in SCS-15 items similarly indicate less connectedness. For purposes of interpretation and to visually enhance class differences, the graph below is partially sorted first by probability of Class 1 (low to high) and then Class 3 (high to low) beginning when Class 1 plateaus at 1.00. (The standard graphical output displays the items as

TABLE 1 Latent class analysis model fit statistics

Model	Log-likelihood	AIC	BIC	ssaBIC	LRT	LRT *p* value	Entropy
2-class	−20957.24	42056.74	42405.49	42179.99	2742.71	<0.0001	0.909
3-class	−20250.94	40715.88	41241.86	40902.02	1406.94	<0.0001	0.970
4-class	**−19785.59**	**39857.18**	**40560.13**	**40105.95**	**926.98**	**0.2444**	**0.918**
5-class	−19536.487	39430.97	40310.89	39742.37	496.21	0.0057	0.932
6-class	−19324.34	39078.69	40135.57	39452.71	424.68	0.0017	0.932
7-class	−19132.14	38766.28	40000.12	39202.93	382.06	0.1290	0.877

Abbreviations: AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; LRT, Lo–Mendell–Rubin likelihood ratio test; ssaBIC, sample size adjusted Bayesian Information Criterion.
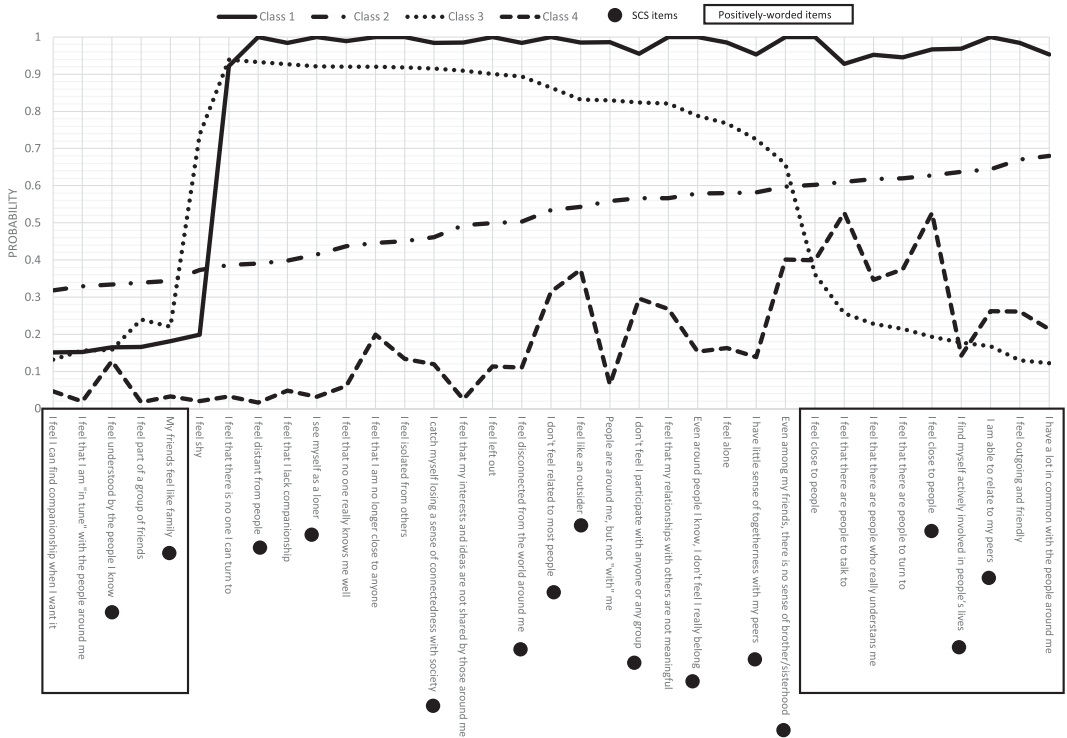
FIGURE 1 Probabilities of class membership for a four-class solution based on the UCLA and 15-item Social Connectedness Scale (SCS-15) items

they were ordered during analysis, from UCLA 1 to UCLA 20, followed by SCS-15 items 1–15, and can be seen in a Supplementary Figure 1.) Here, these inferred profiles are constructed to understand types of behaviors and symptoms for distinguishable experiences of loneliness and connectedness.

Class 1 – *Lonely and Disconnected* – has the highest item probabilities (14 items above a 0.9 along the top of the graph in Figure 1) in affirming a majority of the statements about feeling lonely and disconnected (i.e., responding with "sometimes," "often," "somewhat agree," or "agree" to statements such as "I feel alone"). Class 1 also has the highest probabilities in negating a majority of the statements about feeling connected and close to people (i.e., responding with

"never," "rarely," "somewhat disagree," or "disagree" to statements such as "I feel close to people"). This class had the highest mean UCLA score (61.69) and 100% of individuals scored above a 50, and the lowest SCS-15 score (39.13) with no one scoring above a 47. The individuals in Class 1 had the highest mean age of 29.3 years, and the largest proportions of Millennials (100%), males (93%), White individuals (77.8%), individuals with more than a high school degree and less than a Bachelor's (80.9%), and individuals living with two to three other people (84.13%). All individuals in Class 1 scored as having significant depressive symptoms on the CES-D-10, and 93.7% scored in the range of Moderate to Severe anxiety on the GAD-7. 66.7% scored in the range of Risky to Severe drinking on the AUDIT.

Class 2 – *Moderately Lonely and Disconnected* – has probabilities between 0.3 and 0.7 for each of the loneliness and connectedness items. They had the mean UCLA score of 50.65 (slightly heightened as compared to pre-pandemic prevalence of loneliness: mean scores of 48.87 for 18–25 year olds and 44.92 for 26–34 year olds on the UCLA Loneliness Scale (Cigna, 2018), with 47.5% of Class 2 members scoring above a 50. The mean SCS-15 score was 52.94, with 80% scoring above a 47. The individuals in this largest class had a mean age of 28.4 years, were 89.4% Millennials, and were 53% male. This group comprised the highest proportions of non-White individuals (50.2%) with 15.1% Black/African American, 23.3% Hispanic, and 11.8% Other. 55.3% had a bachelor's degree and 65.9% lived with two to three other people. This group, though showcasing moderate loneliness and connectedness, still scored with some heightened mental health symptoms, as 81.2% reported significant depressive symptoms, and 59.7% with Moderate to Severe anxiety. They also had 49.2% scoring Risky to Severe drinking, and 14.8% Moderate to Severe Drug Use.

In Class 3 – *Ambivalent Feelings* – there were high probabilities in statements affirming negatively worded items in particular (i.e. responding with "sometimes," "often," "somewhat agree," or "agree" to statements such as "I feel that there is no one I can turn to"), while simultaneously affirming positively worded items, such as "I feel outgoing and friendly." They had the second highest mean UCLA score (53.12), with 79.8% scoring above a 50. The mean SCS-15 score was 48.27, with 56% scoring above a 47. The individuals in Class 3 had a mean age of 28.7 years, 86.4% were Millennials, 48.7% were male, and 63.1% were White. 48.5% had a bachelor's degree and 64.1% lived with two to three other people. 100% reported significant depressive symptoms, and 92.4% reported Moderate to Severe anxiety. Class 3 had the highest proportion of drinkers scoring in the range of Risky to Severe (79.8%) and the highest proportion of drug users scoring in the range of Moderate to Severe (26.8%).

Class 4 – *Connected and Not Lonely* – showcases very low probabilities in affirming statements about feeling lonely and disconnected, and low probabilities in negating statements about feeling connected and close to people. This class had the lowest mean UCLA score (37.19) and only 1.2% scoring above a 50. They also had the highest SCS-15 score (67.67), with 100% of individuals scoring about a 47. The individuals in Class 4 had the lowest mean age at 26.1 years and the lowest proportion of Millennials (71.5%) They were also 51.1% Male, 59.5% White, and 27.3% Hispanic. 41.3% had a bachelor's degree and 46.5% lived with two to three other people. The majority of individuals in this class have no alarming symptoms of depression, anxiety, or substance use.

Detailed demographic characteristics of each class are displayed in Table 2, while the mean scale scores and breakdown of individuals in clinical cut off ranges are shown in Table 3.

4 | DISCUSSION

The results of our study captured a novel depiction of loneliness and connectedness being experienced by young adults during COVID-19. By employing a latent class approach to examining both loneliness and connectedness scale items together, as opposed to only a cumulative summarized perspective, we were able to depict different types of symptomatology experienced by the young adults in our sample. Then, in assessing the demographic, behavioral, and psychosocial characteristics among these classes, we observe telling distinctions between four unique categories of individuals. The distinction between Class 2 – Moderately Lonely and Disconnected, and Class 3 – Ambivalent Feelings, is especially important. While the mean UCLA and SCS-15 scales scores do not highlight noticeable differences between these two groups, the item-level approach separates individuals into two distinct

TABLE 2 Characteristics by class membership

Characteristics		Class 1:"Lonely and Disconnected"(N = 63)	Class 2:"Moderately Lonely and Disconnected"(N = 575)	Class 3:"Ambivalent Feelings"(N = 198)	Class 4:"Connected and Not Lonely"(N = 172)
Age	M (SD)	29.32 (1.64)	28.36 (3.95)	28.65 (4.38)	26.10 (4.21)
	Gen Z	0 (0%)	61 (10.61%)	27 (13.64)	49 (28.49%)
	Millennials	63 (100%)	514 (89.39%)	171 (86.36%)	123 (71.51%)
Gender[a]	Male	56 (93.33%)	212 (47.01%)	55 (48.67%)	47 (51.09%)
	Female	4 (6.67%)	239 (52.99%)	58 (51.33%)	44 (47.83%)
Race/Ethnicity	Black	1 (1.59%)	87 (15.13%)	11 (5.56%)	10 (5.81%)
	Hispanic	6 (9.52%)	134 (23.3%)	58 (29.29%)	47 (27.33%)
	White	49 (77.78%)	286 (49.74%)	125 (63.13%)	103 (59.88%)
	Other	7 (11.11%)	68 (11.83%)	4 (2.02%)	12 (6.98%)
Education	High school or less	1 (1.59%)	20 (3.48%)	3 (1.52%)	10 (5.81%)
	More than HS, LT BA	51 (80.95%)	188 (32.7%)	83 (41.92%)	64 (37.21%)
	BA/BS	7 (11.11%)	318 (55.3%)	96 (48.48%)	71 (41.28%)
	Graduate degree	4 (6.35%)	49 (8.52%)	16 (8.08%)	27 (15.7%)
Household	Live alone	3 (4.76%)	18 (3.13%)	9 (4.55%)	10 (5.81%)
	1 other person	3 (4.76%)	50 (8.7%)	16 (8.08%)	54 (31.4%)
	2–3 others	53 (84.13%)	379 (65.91%)	127 (64.14%)	80 (46.51%)
	4–6 others	4 (6.35%)	127 (22.09%)	40 (20.2%)	28 (16.28%)
	7+ others	0 (0%)	1 (0.17%)	6 (3.03%)	0 (0%)

Abbreviation: SD, standard deviation.

[a]n missing = 292, 1 other.

TABLE 3 Mean scale scores and cut off frequencies by class membership

Symptomatology		Class 1:"Lonely and Disconnected"(N = 63)	Class 2:"Moderately Lonely and Disconnected"(N = 575)	Class 3:"Ambivalent Feelings"(N = 198)	Class 4:"Connected and Not Lonely"(N = 172)
Loneliness	Mean score (SD)	61.79 (3.07)	50.65 (5.01)	53.12 (3.57)	37.19 (6.21)
	Range	58–80	36–71	45–65	20–51
	% >50	100%	47.47%	79.80%	1.16%
Connectedness[a]	Mean score (SD)	39.13 (4.90)	52.94 (6.72)	48.27 (5.68)	67.67 (7.3)
	Range	18–44	28–81	21–62	49–90
	% >47	0%	80%	56%	100%
Depression	Mean score (SD)	17.33 (2.75)	13.82 (4.65)	16.74 (2.75)	8.8 (5.15)
	N (% of class) Not depressed (0–9)	0 (0%)	108 (18.78%)	0 (0%)	105 (61.05%)
	Significant depressive symptoms (10+)	63 (100%)	467 (81.22%)	198 (100%)	67 (38.95%)
Anxiety[b]	Mean score (SD)	12.14 (1.94)	10.44 (4.0)	13.35 (3.01)	6.48 (4.65)
	N (% of class) Little to no anxiety (0–4)	0 (0%)	48 (8.42%)	2 (1.01%)	64 (37.21%)
	Mild anxiety (5–9)	4 (6.35%)	182 (31.93%)	13 (6.57%)	72 (41.86%)
	Moderate anxiety (10–14)	56 (88.89%)	253 (44.39%)	115 (58.08%)	26 (15.12%)
	Severe anxiety (15–21)	3 (4.76%)	87 (15.26%)	68 (34.34%)	10 (5.81%)
Drinking[c]	Mean score (SD)	8.56 (4.71)	8.76 (7.95)	12.92 (7.5)	5.24 (5.24)
	No alcohol (0)	2 (3.17%)	161 (28.5%)	14 (7.07%)	24 (13.95%)

TABLE 3 (Continued)

Symptomatology			Class 1: "Lonely and Disconnected" (N = 63)	Class 2: "Moderately Lonely and Disconnected" (N = 575)	Class 3: "Ambivalent Feelings" (N = 198)	Class 4: "Connected and Not Lonely" (N = 172)
	N (% of class)	Low risk (0–7)	19 (30.16%)	126 (22.3%)	26 (13.13%)	109 (63.37%)
		Risky (8–15)	36 (57.14%)	139 (24.6%)	45 (22.73%)	27 (15.7%)
		Harmful (16–19)	2 (3.17%)	77 (13.63%)	57 (28.79%)	8 (4.65%)
		Severe (20+)	4 (6.36%)	62 (10.97%)	56 (28.28%)	4 (2.33%)
Drug use[d]	Mean score (SD)		1.87 (3.44)	0.86 (2.03)	1.93 (3.29)	0.51 (1.3)
	N (% of class)	No drug use (0)	11 (73.33%)	463 (80.52%)	138 (69.7%)	136 (79.07%)
		Low Level (1–2)	0 (0%)	27 (3.54%)	7 (3.54%)	23 (13.37%)
		Moderate level (3–5)	1 (6.67%)	46 (8.0%)	18 (9.09%)	10 (5.81%)
		Substantial level (6–8)	2 (13.33%)	35 (6.09%)	12 (6.06%)	2 (1.16%)
		Severe Level (9–10)	1 (6.67%)	4 (0.7%)	23 (11.62%)	1 (0.58%)
Substance use categories[e]	N (% of class)	"Safe"	3 (21.43%)	190 (33.87%)	17 (8.72%)	53 (38.13%)
		"Minor"	7 (50.0%)	274 (48.84%)	120 (61.54%)	54 (38.85%)
		"Serious"	0 (0%)	21 (3.74%)	5 (2.56%)	21 (15.11%)
		"Double Serious"	1 (7.14%)	46 (8.2%)	19 (9.74%)	9 (6.47%)
		"Double Severe"	3 (21.43%)	30 (5.35%)	34 (17.44%)	2 (1.44%)

Abbreviation: SD, standard deviation.

[a]n missing = 1 in Class 2.

[b]n missing = 5 in Class 3.

[c]n missing = 10 in Class 2.

[d]n missing = 48 in Class 1.

[e]n missing = 49 in Class 1, 14 in Class 2, 3 in Class 3, 33 in Class 4.

classes. The young adults in Class 2 show a higher probability of responding in a more lonely/less connected manner to positively worded items (i.e., not feeling particularly "close to people," "outgoing," or "actively involved"), whereas those in Class 3 show a higher probability of responding in a more lonely/less connected manner to negatively worded items (i.e., feeling particularly "distant," "alone," and that they had "no one to turn to"), even while still endorsing positively-worded items. This distinction allows us to identify negative affectivity in Class 3; these individuals are experiencing negative emotions and poor self-concept, indicating that they are feeling "disconnected", that they are "loners," and that they "lack companionship." While we did not directly measure negative affectivity, the elevated negativity in these individuals' self-evaluations may reflect pervasive differences in negative emotionality towards their disconnectedness and loneliness (Watson & Clark, 1984) and therefore might warrant attention, especially as it is coupled with heightened levels of depression, anxiety, and substance use. By adding a rich perspective of item-level responses, this exercise delineates a group suffering more harmful levels of loneliness, disconnectedness, and associated psychosocial symptoms. Thus, examining the established sum scores for these measures alone may mask the risk. While mean UCLA and SCS-15 scores may not alert clinicians to the severity of their symptoms any more than Class 2, responses to the negatively worded items in particular could indicate the importance for assessing whether there is accompanying negative symptomatology. As the LCA has good entropy - indicative of very good class separation - there may be a possibility of using the items to get a better prediction of those at risk. This would require replication to establish the generalizability of the latent class results.

Another finding to emphasize is the delineation of classes with extreme levels of loneliness and disconnectedness, as we see in Class 1 – Lonely and Disconnected, and in Class 3 – Ambivalent Feelings, and that the individuals in these classes are also reporting intense levels of depression and anxiety and, in the case of Class 3, high levels of substance use. While Class 1 and Class 3 are distinct, they tell a similar story – individuals feeling distant and disconnected from others during COVID-19 are also at high risk for depressive and anxious feelings and substance ue should be the priority population for outreach and intervention. The success and cost-effectiveness of adapted electronic health messaging during COVID-19 to intervene around harmful behaviors like risky drinking and substance use have been demonstrated (Hanson et al., 2021). Assessment of loneliness and social connectedness may aid in targeting of these efforts.

The challenge in an approach targeting the individuals at highest risk, and another key discovery of this investigation, is that the especially lonely young adults in Classes 1 and 3 may be overlooked when considering only an outward demonstration of their emotions and appearance of connectedness. Because they live with others, are active on social networking sites, and have a high probability of indicating that they are part of a group of friends, young adults in these classes may not showcase typical characteristics of individuals who feel very alone and lack a sense of belongingness. Even among the class with almost consistently high probabilities in affirming loneliness and negating connectedness, there are six statements found in the far left of the graph in Figure 1 for which the probabilities are low. These statements indicate that this most lonely group still reports feeling "in tune" and "understood by those around them, and that they are "part of a group of friends" who "feel like family." These young adults are not "shy," and indicate they feel they can find companionship when they want it. Also, as many responded that given the circumstances they are doing "Good" to "Excellent" (82.54% among Class 1; 66.67% among Class 3), these young adults may not perceive their symptoms to be elevated or may not validate them to consider reaching out for help.

Assessment of the class opposite to these high-risk groups offers insight as to the protective role of connectedness during the pandemic. As most of the sample reports heightened symptomatology across all scales, one class does not: Class 4 – Connected and Not Lonely. This class comprises a group of young adults who are not feeling lonely or disconnected and are an exception to the pattern of harmful mental health discovered during the pandemic. Individuals in Class 4 seem to be most resilient and coping well given the circumstances, with low levels of loneliness, disconnectedness, depression, anxiety, and substance use.

The latent profiles uncovered by this study are consistent with frameworks presenting the complex interrelatedness and distinction between loneliness and connectedness. Regardless of the quantity of relationships they are objectively involved in, individuals who *perceive* the absence of closeness with themselves, their community, or the larger society, may remain at high risk for loneliness and other negative emotions and behaviors. Loneliness and

connectedness are often highly correlated, yet their ultimate distinction and relationship may offer insight between an individual's experiences and how they perceive and report on their feelings. Distinct from objective social isolation or solitude, loneliness is the distressing feeling of lacking needed social connections (Hawkley & Cacioppo, 2010). Individuals may therefore report loneliness even while they have several social connections, as we see in Class 1 and Class 3. Social connectedness, by comparison, reflects cognitions of enduring interpersonal closeness with the social world (Lee et al., 2001). The emphasis on social connectedness is on the independent self in relation to others, making it distinct from belongingness and loneliness. The broader multi-factorial construct of social connection includes other dimensions (Holt-Lunstad et al., 2017) all important to understand holistically when considering public health outcomes. Without a sense of social connection, individuals may feel unhappy and frustrated in the social world (Duru & Poyrazli, 2011). As subjective happiness has been shown to mediate the relationship between social connectedness and loneliness, mental health professionals may focus on building social connectivity as a way of supporting the subjective well-being and happiness, and thereby combating loneliness (Satici et al., 2016).

There are several limitations to this study. The study design captured cross-sectional data using social media recruitment which disallows determination of any cause-effect relationships between behaviors and symptoms. Generalizability is also limited by the recruitment method. Furthermore, the nature of self-report survey data cannot rule out systematic errors such as response and sampling biases which may impact the results and challenge interpretation. Limitations of the LCA approach also include two important issues identified by similar work (Lanza & Rhoades, 2013) which are (1) the recoding of continuous indicators into categorical variables, as this could result in a loss of information and (2) the issue of reification, as it may be easy to conclude that latent classes identified in an analysis represent actual individuals in the population. This last limitation points to the need to replicate results to see if the patterns identified herein generalize to other samples and other contexts outside of a pandemic.

The implications of this study should be incorporated in various contexts. First, these findings highlight the severity of loneliness and promise of connectedness among young adults in the United States, and therefore mental health assessment among these generations should include measures of loneliness and connectedness to identify and define mental health problems and drive solutions. As social connectedness can be used to accurately forecast who is at risk, measuring it is critical for prevention efforts (Holt-Lunstad et al., 2017); better characterization of the specific problem profiles could offer insight to prevention and treatment alternatives. Second, individuals suffering negative mental health implications, whether due to, or in addition to, loneliness and disconnectedness, may be challenging to identify only by social characteristics, or even mean scale scores alone. Evaluation of item-level responses may be more sensitive and therefore useful in determining those in need of outreach and intervention. Finally, social connectedness must be emphasized and promoted among these young generations as they continue to develop and grow into an increasingly virtual environment.

Young adults, reporting the highest levels of loneliness compared to other generations, comprise the population becoming increasingly disengaged from traditional institutions of connection such as marriage, religion, and political affiliation (McLeigh & Boberiene, 2014). And while new technologies offer platforms to increase social networking in this evolving era, they have also contributed to loneliness, social isolation, depression, and decreased wellbeing (Johnson, 2018; Primack et al., 2017). Young generations are growing more isolated and suffering increased consequences on physical and mental health, and the pandemic's social restrictions showcase an extreme version of the direction we may be headed. The symptomatology uncovered in this study is corroborated by other studies which have also discovered high rates of loneliness, anxiety, posttraumatic stress disorder, depression, psychiatric disorders, and substance use among young adults during COVID-19 (Cao et al., 2020; Chang et al., 2020; Huckins et al., 2020; Li & Wang, 2020, Rudenstine et al., 2021; Varma et al., 2021). However, as this study further uncovers, the Connected and Not Lonely class, distinguishable by minimal loneliness and a higher level of social connectedness, do not report the distressing levels of anxiety, depression, and substance use found among their peers who are lonely. These young adults felt they were close to people and not alone in the midst of the pandemic and weathered the mental health catastrophe impacting many others. This group's adaptability offers hope that promotion, prevention, and intervention strategies targeting social connection may help younger generations cope with the aftermath of the pandemic and bolster their resilience into the future.

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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PEER REVIEW

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