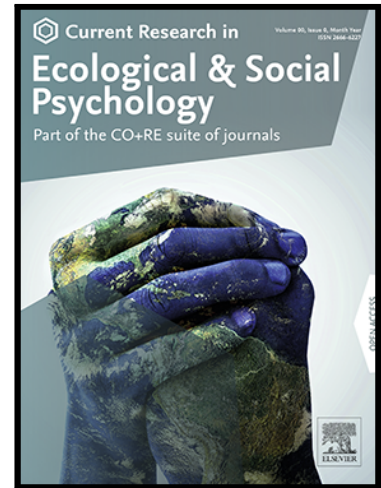


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**Virtual Social Interaction and Loneliness
Among Emerging Adults
Amid the COVID-19 Pandemic**

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Abstract

Many social activities moved online during the global COVID-19 pandemic, yet research investigating whether virtual social interactions facilitate social connectedness has been inconclusive. In this study, participants completed online questionnaires assessing objective social isolation, loneliness, mental health, and virtual social interactions. There was clear evidence for worsening mental health among emerging adults during the COVID-19 pandemic characterized by large increases in depressive symptoms (mean increase = 8.35, 95% CI [6.97, 9.73], $t(118) = 118$, $p < .001$), and large decrements in happiness (mean decrease = -0.71, 95% CI [-0.84, -0.57], $t(118) = 10.09$, $p < .001$) and social satisfaction (mean decrease = -0.81, 95% CI [-1.00, -0.62], $t(115) = 8.28$, $p < .001$) post-pandemic onset. In line with expectations, those living in larger households amid the pandemic reported lower levels of loneliness and higher levels of happiness. A negative association was found between household size (an index of objective social isolation) and loneliness, $b = -3.01$, $t(79) = 2.60$, $p = .011$, 95% CI [-5.32, -0.71], and a positive association was found between household size and happiness, $b = 22.86$, $t(75) = 3.30$, $p = .001$, 95% CI [9.06, 36.65]. However, contrary to expectations, there was no association between loneliness and frequency of virtual social interactions. There was also no association between frequency of virtual social interactions and either happiness or depression. More research investigating social connectedness in the context of virtual social interactions is warranted.

Keywords: COVID-19, emerging adulthood, mental health, virtual social interaction, loneliness, social isolation

**Virtual Social Interaction and Loneliness
Among Emerging Adults
Amid the COVID-19 Pandemic**

Modern technology has drastically changed the way we socialize and communicate, facilitating real-time virtual social interactions such as messaging, voice and video calling, gaming and social media exchanges (Smith and Anderson, 2018). While the capacity for social connection in this way has expanded possibilities for social contact, whether virtual social interactions provide the same opportunity for connectedness as real-life social interactions remains an understudied, but critical question. As social interactions occur more frequently (and sometimes exclusively) online, it is important to understand whether virtual interactions satisfy our need for social connection and mitigate loneliness. Further, when physical proximity is impossible, or ill advised, as is the case with ongoing physical and social distancing recommendations amid the COVID-19 pandemic, can virtual social interactions help combat loneliness and promote mental health?

So far, research has provided inconclusive empirical answers to the aforementioned questions. Some types of virtual social interactions can be problematic – such as cyberbullying and participation in groups promoting dangerous pro-anorexia content and self-injury behaviors (Kowalski et al., 2019; Margherita and Gargiulo, 2018). However, other virtual social interactions can be positive – for example online support groups for those with depression (Breuer and Barker, 2015). Studies investigating the quality of virtual social interactions (including Facebook usage, online gaming, and online dating) have shown that they can be similar in meaning, intimacy, and stability as real-life relationships (Ellison et al., 2007; Hsu et al., 2011; Parks and Roberts, 1998; Whitty, 2008). In line with such findings, some researchers have found a positive relationship between Facebook use and the maintenance and creation of social capital (such as employment opportunities, community interaction, and finding new friends and emotional support; Ellison et al., 2007; Hsu et al., 2011). In an experimental study, virtual social

interactions (anonymous online chats) were shown to reduce loneliness in university students (Shaw and Gant, 2002). Further, online peer support groups have been shown to reduce feelings of isolation (Prescott et al., 2020) and serve as a virtual meeting place to practice social skills for use offline (Smit et al., 2021).

However, virtual social interactions can also have negative effects on mental health. Passive social media use (defined as monitoring of other people's lives without direct exchange) has been found to be associated with social comparisons, envy, and lower subjective wellbeing (Verduyn et al., 2017). Time spent on Facebook has also been associated with increased loneliness in young adults (Lou et al., 2012). In another recent study, experimentally manipulating social media abstinence did not affect self-reported loneliness, wellbeing, or quality of day (Hall et al., 2021). In sum, the literature is mixed on whether digital technology increases meaningful social connections and whether those virtual connections support mental health.

Meaningful social connections are particularly important during specific stages of development. Adolescents have been shown to be hypersensitive to social stimuli, both positive and negative (Foulkes and Blakemore, 2016), and particularly to social exclusion (Blakemore and Mills, 2014). While the United Nations and World Health Organization define adolescence as the period between approximately 10-20 years of age (WHO, 1965; WHO, 1977; WHO, 2015), more recent research has proposed including young adults (up to age 25; Sawyer et al., 2018) in the definition of adolescence due to continued refinements in brain structure and function associated with affect regulation (Silvers et al., 2017), social relationships (Mills et al., 2014), and executive functioning (Simmonds et al., 2014) during this period. Other researchers have posited a redefinition of the period between an individual's late teens and early twenties as a unique stage of maturation called 'emerging adulthood' (Arnett, 2000; Arnett, 2011; Hochberg and Konner, 2019). As societal expectations have shifted, more individuals spend a longer period navigating and exploring peer relationships, continuing their education, and starting their careers into this emerging

adulthood period (Sawyer et al., 2018), and virtual social interactions become increasingly important at this time too (Thayer and Ray, 2006). In contrast to childhood and early adolescence (when virtual social interactions are conducted primarily with existing friends), research has shown that emerging adults forge new social connections online, communicating with both friends and strangers (Thayer and Ray, 2006).

The mandated social-distancing measures occasioned by the arrival of the novel coronavirus (COVID-19) around the globe, have reduced in-person social interactions for many people and, at least for a time, moved much social contact into the virtual domain. While social isolation is an objective state characterized by low social interactions (in any form), loneliness is subjective. Loneliness (perceived social isolation) has been described as the difference between the quantity and quality of one's desired and actual social experiences (Hawkley and Cacioppo, 2010). Early reports on "lockdown loneliness" during the COVID-19 pandemic lockdown revealed that emerging adults reported increases in loneliness after the onset of COVID-19 (Shah et al., 2020). Nearly half (44%) of young adults (18-24 years old) in the United Kingdom reported feeling lonely during lockdown (compared to only 16% before the lockdown; Mental Health Foundation, 2020). Loneliness also increased during COVID-19 in samples of young adults in the United States (Lisitsa et al., 2020), Switzerland (Elmer et al., 2020), and Canada (Hamza et al., 2021).

While loneliness and objective in-person social isolation are distinct, reductions in in-person social contact (e.g., through social distancing) can cause loneliness and social craving (Tomova et al., 2020). Moreover, loneliness is associated with decrements in mental health, including the onset of depression (Richardson et al., 2017), with some studies reporting that lonely individuals are 5.8 to 40 times more likely to score above clinical cutoffs for depression (Loades et al., 2020; Roberts and Chen, 1995; Stickley et al., 2016). To combat loneliness and mitigate the negative effects of social distancing, it has been suggested that digital technologies might be of assistance (Galea et al., 2020; Orben et al., 2020). Indeed, initial research has shown that increased virtual social interactions

(including meetings over Zoom, phone calls, texts, virtual gaming, or other similar means of communication that did not involve in-person interaction) with close others amid the pandemic were related to higher levels of wellbeing in both younger (mean age 20.54) and older (mean age 59.15) adults (Brown and Greenfield, 2021; Sahi et al., 2021).

In the current study, we investigated changes in virtual social interactions (across a variety of platforms), objective in-person social isolation (number of in-person social contacts), depression, happiness, and social needs in emerging adults amid the COVID-19 pandemic. We also sought to identify if a higher frequency of virtual social interactions during the pandemic protected against loneliness in this group. Finally, whether virtual social interactions were associated with emerging adults' happiness and depression levels was explored.

Context of data collection

COVID-19, a novel coronavirus, was first identified in Wuhan, China in December 2019 before being declared a global pandemic on March 11th, 2020 ("Progress report on the coronavirus pandemic," 2020). Authorities worldwide imposed lockdowns, travel restrictions, contact tracing, and other measures which severely disrupted social, personal, and professional life. This study was conducted at the University of California, Los Angeles (UCLA). The majority of the sample (77%) were located in California at the time of the survey, a further 16% of participants were located in other states in the United States, 5% of participants were internationally located, and 2% did not answer this question. Data collection for this study commenced on April 28th, 2020 and concluded on June 4th, 2020. A stay-at-home order was imposed in California on March 19th, 2020 that was not lifted until January 25th, 2021. As such, social distancing guidance/mandates in California remained comparable for the duration of data collection. On March 10th, 2020 UCLA suspended in-person classes for the remainder of the winter quarter and students were encouraged to begin the spring quarter from home. As the COVID-19 situation progressed, students were encouraged to remain home after spring break if possible, and remote

instruction was extended through Spring 2021.

Methods

Participants

One-hundred and nineteen individuals participated in the study (mean age = 19.94 years, $SD = 1.42$ years, range 18-25 years; 95 female; see the supplement for more detailed demographic information). Participants were recruited both using the UCLA Psychology Department Subject Pool (SONA), as well as from the public using advertisements posted on social media platforms such as Twitter, Instagram, and Facebook. Participants had to be 18 years or older to enroll. The protocol for this study was approved by the UCLA institutional review board and participating individuals provided online consent for study participation.

Procedure

The data for this study were collected as part of a larger survey study which investigated the relationship between physical and emotional symptoms and health amid the COVID-19 pandemic. Study data were collected and managed using REDCap (Research Electronic Data Capture; Harris et al., 2019; Harris et al., 2009) hosted at UCLA. Participants completed the survey online and participation was anonymous. The current study considers a subset of the questionnaires (those pertaining to social interactions, loneliness, depression, happiness, and social needs) from the larger study. The study was preregistered on the Open Science Framework (OSF; <https://osf.io/sw4kp>). The supplement and deidentified data are available (<https://osf.io/7sjng>) along with materials (<https://osf.io/nf2bv>).

Measures

Virtual social interaction

Virtual social interaction (VSI) frequency, feelings of connection, number of practices, and primary practice were assessed using the Adolescent Social Connection and Coping during COVID-19 questionnaire (ASC; Pfeifer, 2020). Although the questionnaire was designed for adolescents (rather than emerging adults) the lack of language in the questionnaire referring to adolescents maintained the face validity of the measure for use in the emerging adult population. Frequency of virtual social interaction was measured on a seven-point scale from “Never” to “Almost constantly”. Feelings of connection derived from virtual social interaction were measured on a seven-point scale from “Very socially disconnected” to “Very socially connected”. Practices, referred to in communication research as ‘affordances’ (Evans et al., 2017), were defined as methods used for virtual social interaction and included messaging/texting, voice calls, video calls, social media, online gaming, and any ‘other’ method (which could be typed into a text box). Number of practices was calculated by taking a sum of the methods used. In the same question, participants were also asked to indicate their primary practice. Participants were asked about each of these components in reference to four domains: with 1) friends, 2) acquaintances, 3) family members, and 4) romantic partners, both retrospectively (in a typical two-week period before the onset of COVID-19) as well as currently (in the past two weeks during COVID-19). For the purposes of this paper, we report results from the domain of ‘friends’ as peer relationships are particularly important for emerging adults (Khullar et al., 2021)(results from other domains can be found in the supplement).

Objective in-person social isolation

Objective levels of in-person social isolation were assessed in three ways: (1) household size, (2) social distancing compliance, and (3) frequency of in-person contact with friends (even if socially distanced). Household size was measured by participants’

self-reported number of persons in their household (during COVID-19). Social distancing compliance was assessed by a single question asking participants how often they had been social distancing on a five-point scale. Frequency of in-person contact with friends within the last two weeks was measured on a seven-point scale from “never” to “almost constantly”. Over 95% of participants reported social distancing “often” or “always” and over 87% of participants reported seeing friends in-person less than once a week amid the pandemic. As levels of social distancing were high, in-person social contact with friends was low (particularly compared to retrospectively reported pre-pandemic levels of in-person social contact with friends, $M_{before} = 3.38$, $SD_{before} = 1.42$, $M_{during} = 0.92$, $SD_{during} = 1.37$, $t(117) = 15.24$, $p < .001$), and variability between participants on these two variables was low, we did not consider these variables further, using only household size as our measure of objective in-person social isolation.

Loneliness

Loneliness was measured using the UCLA Loneliness Scale (Russell et al., 1978), which is a composite measure of both social and emotional loneliness. Participants were asked to report how they felt in the last two-week period (i.e., during COVID-19).

Depression

The Beck Depression Inventory II was used to measure depression (Beck et al., 1996). Participants were asked to report how they felt in the last two-week period (i.e., during COVID-19) as well as retrospectively for a typical two-week period before the onset of COVID-19.

Happiness

Happiness was assessed in two ways, current happiness and change in happiness. Current happiness was assessed using a modified version of the Subjective Happiness Scale (Lyubomirsky and Lepper, 1999). Here, participants were presented with four statements

and/or questions and were asked to indicate the point on the scale they felt was most descriptive of them over the last two weeks during COVID-19. The original Subjective Happiness Scale is presented in a seven-point Likert format, with higher scores representing greater happiness. To have a more fine-grained measure of happiness in this study, participants were instead shown a sliding scale which corresponded to a continuous scale from 0 – 100 for each item. For the purpose of comparing participants' current happiness scores to previous research, each of the four items was converted to a seven-point scale using the equation – $[\text{raw score}/100]*6+1$. The fine-grained scale was used in all other analyses.

Change in happiness was assessed by asking participants to rate how their general level of happiness had changed since the onset of COVID-19 (on a five-point scale anchored with the statements 'much less happy' to 'much happier'). Participants ratings on this scale were called 'happiness change'.

Friendship

Participants rated how well their friends met their social needs (from not at all to extremely well on a five-point scale), both in the last two weeks (since the onset of COVID-19), and in a typical two-week period before the onset of COVID-19. This variable was called 'social needs met'.

Hypotheses

We hypothesized that amid COVID-19, frequency of virtual social interactions (VSI) would be negatively associated with loneliness.

In addition to this preregistered hypothesis, we analyzed changes in virtual social interactions, objective in-person social isolation, depression, happiness, and social needs. We also explored associations between virtual social interactions and both happiness and depression.

Analyses

Pre- post-COVID-19 changes in virtual social interaction, objective in-person social isolation, depression, social needs, and happiness

To determine if there were any pre- (retrospective) to post-COVID-19 onset (current) changes in VSI-frequency, VSI-feelings of connection, objective in-person social isolation (persons in household), depression, and whether social needs were being met, we performed a series of paired samples t-tests using Bonferroni correction for multiple comparisons (6 t-tests in total) with adjusted alpha levels of .008 (.05/6). To investigate changes in the distribution of VSI primary practice pre- to post-COVID-19-onset and household composition, we conducted nominal symmetry tests (Cohen, 1988). Finally, we used a one-sample t-test with a Bonferroni correction for multiple comparisons with adjusted alpha levels of .008 (.05/6) to investigate whether participants rating of happiness change were significantly different than zero, which represented “no change”.

Comparison to non-COVID-19 samples in loneliness, depression, and happiness

To determine if our sample was exhibiting comparable levels of loneliness, depression and happiness to other samples of emerging adults (assessed before the onset of COVID-19), we compared mean scores from these measures in our sample with those reported in past work (Beck et al., 1996; Lyubomirsky and Lepper, 1999; Russell, 1996) using independent samples t-tests with Bonferroni correction for multiple comparisons (3 t-tests in total) with adjusted alpha levels of .017 (.05/3).

Relationship between loneliness and both objective in-person social isolation and virtual social interactions

To understand how objective in-person social isolation and virtual social interactions during COVID-19 were associated with participants' ratings of loneliness amid

COVID-19, we ran a multiple linear regression. Household size (our measure of objective in-person social isolation) and our four measures of VSI (frequency, feelings of connection, number of practices, and primary practice) were entered into the model as predictors. Age and sex were included as covariates. Participant loneliness during COVID-19 was entered as the outcome of interest.

Relationship between current depression and current happiness and both objective in-person social isolation and virtual social interactions

Because loneliness was not elevated in our sample during COVID-19 compared to a pre-pandemic sample (contrary to expectations), we opted to use two measures that did show elevation during COVID-19 (depression and happiness) as additional outcome variables in exploratory analyses. The same multiple linear regression discussed above was run but using depression and happiness (instead of loneliness) as the outcomes of interest. As three outcomes of interest were investigated (loneliness, depression, and happiness) a conservative Bonferroni correction was used for multiple comparisons and the adjusted alpha level was .017 (.05/3).

Data exclusions

We included eight attention check items in this study. Attention checks were embedded within eight questionnaires spread across the study (1 check per questionnaire). For example, participants were presented a Likert scale and instructed “To ensure that you are giving this study your complete attention, please select ‘Seldom’”. Anyone who failed more than four of these items was excluded from the analyses. One hundred and forty-eight individuals enrolled in the survey ($n = 148$), from which $n = 8$ participants were excluded due to failing more than four attention checks and a further $n = 21$ participants were excluded due to not matching the age requirements (18- 25 years of age) for this particular set of analyses, which are focused on the emerging adulthood period of development. Thus, our final sample was $n = 119$ individuals.

Missing data

For loneliness, depression, and happiness, a proration was calculated for missing values, up to 30%. Proration was calculated by imputing each participant's missing scores with the mean of their observed scores (mean imputation). Results were similar when calculated with and without mean imputation (results without mean imputation can be found in the supplement). Regression analyses were performed with listwise deletion.

Software

We used R for all our analyses (R Core Team, 2019). A complete list of all R-packages and versions used can be found in the supplement.

Results

Pre- post-COVID-19 change in virtual social interaction, objective in-person social isolation, depression, social needs, and happiness

Participants rated their total frequency of engagement in virtual social interactions with friends as “about once a day” before and during COVID-19, $M_{before} = 3.66$, $SD_{before} = 1.50$, $M_{during} = 3.86$, $SD_{during} = 1.39$, $t(117) = 1.23$, $p = .220$ (Figure 1). On average, participants reported feeling “slightly socially connected” while engaging in virtual social interactions both before and during COVID-19. However, feelings of connection derived from virtual social interactions during COVID-19 were lower, relative to pre-COVID-19 levels, $M_{before} = 5.21$, $SD_{before} = 1.48$, $M_{during} = 4.87$, $SD_{during} = 1.57$, $t(117) = 2.75$, $p = .007$ (Figure 1). Participants reported using approximately three practices on average to participate in virtual social interactions pre-pandemic, and this did not change after the onset of the pandemic, $M_{before} = 3.37$, $SD_{before} = 1.36$, $M_{during} = 3.33$, $SD_{during} = 1.58$, $t(117) = 0.30$, $p = .764$ (Figure 1).

As shown in Figure 2, both before and after the onset of COVID-19, text messaging was by far the most popular primary practice for virtual social interactions with friends,

followed by video calling. There were no changes in the distribution of primary practice used for virtual social interactions pre- to during-COVID-19 using a pairwise nominal symmetry test (Figure 2).

Objective in-person social isolation was measured as household size. Participants reported an average household size of 2.43 ($SD = 1.38$) before the onset of COVID-19, and 2.90 ($SD = 1.48$) after the onset of COVID-19. This increase was not significant, $t(91) = 1.99$, $p = .050$, Bonferroni adjusted alpha = .008 (see Figure 1). However, household composition looked different after the onset of COVID-19 (using a pairwise nominal symmetry test) as many participants who reported living with roommate(s) before the pandemic reported living with family amid the pandemic, $p < .001$ (Figure 3).

Participants reported that friends met their social needs “very well” before COVID-19 and “moderately” amid COVID-19, and this decrease was significant, $M_{before} = 4.21$, $SD_{before} = 0.86$, $M_{during} = 3.40$, $SD_{during} = 1.05$, $t(115) = 8.28$, $p < .001$, $d = 0.77$ (Figure 1). On average, participants reported “minimal” depressive symptoms before the onset of COVID-19 ($M = 8.12$, $SD = 8.72$), which significantly increased to “mild” after the onset of COVID-19 ($M = 16.47$, $SD = 10.66$), $t(118) = 12.00$, $p < .001$, $d = 1.10$ (Figure 1). On average, participants also reported that their happiness had decreased after the onset of COVID-19 (happiness change score), $M = -0.71$, $SD = 0.76$, $t(118) = 10.09$, $p < .001$, $d = 0.93$.

Comparison to non-COVID-19 samples in loneliness, depression, and happiness

We explored whether levels of loneliness, depression, and happiness were different to past reports in similar samples collected before COVID-19. An independent samples t-test between loneliness levels in the present sample ($M = 41.07$; $SD = 14.85$) and in a comparable student sample ($M = 40.08$; $SD = 9.50$, $N = 487$; Russell, 1996) revealed similar levels of loneliness, $t(604) = 0.69$, $p = .313$. Although our sample did not exhibit significantly elevated average levels of loneliness relative to Russell (1996), our sample did

exhibit significantly elevated average levels of depression, $M = 16.47$ ($SD = 10.66$) compared to the Beck (1996) university student average, $M = 12.56$ ($SD = 9.93$, $N = 120$), $t(237) = 2.93$, $p = .006$. In addition, our sample reported significantly lower levels of happiness ($M = 4.37$; $SD = 1.33$) than reported in university students from another study conducted prior to COVID-19 ($M = 4.89$; $SD = 1.11$, $N = 551$; Lyubomirsky and Lepper, 1999), $t(663) = 3.90$, $p < .001$.

Relationship between loneliness and both objective in-person social isolation and virtual social interactions

Using multiple linear regression, we examined how objective in-person social isolation (household size) and virtual social interactions (frequency, number, connection, primary practice) were associated with participants' ratings of loneliness amid COVID-19. There was a significant effect of objective in-person social isolation, whereby participants with a higher number of household members (less in-person social isolation) reported lower levels of loneliness during COVID-19, $b = -3.01$, $t(79) = 2.60$, $p = .011$, 95% CI [-5.32, -0.71]. However, the effect of VSI frequency, VSI connection, VSI number of practices, and VSI primary practice were not significant predictors of loneliness during COVID-19 in this sample, nor were there effects of age or sex on loneliness. The full set of statistics and results can be found in Table 1.

Relationship between current depression and both objective in-person social isolation and virtual social interactions

Using multiple linear regression, we examined how objective in-person social isolation (household size) and virtual social interactions (frequency, number, connection, and primary practice) were associated with participants' ratings of depression amid COVID-19. None of the variables were significantly associated with depression during COVID-19 when correcting for multiple comparisons (see Table 2).

Table 1*Loneliness*

	<i>b</i>	beta	<i>SE</i>	<i>t</i>	<i>p</i>
Intercept	46.12	0.00	26.76	1.72	.089
Age	0.11	0.01	1.27	0.09	.931
Sex	2.50	0.06	4.67	0.53	.594
Household Size	-3.01	-0.30	1.16	-2.60	.011*
VSI Frequency	2.32	0.22	1.36	1.71	.092
VSI Connection	-2.05	-0.20	1.16	-1.77	.080
VSI Number	0.68	0.07	1.15	0.60	.552
Primary Practice - Social Media Posting	8.23	0.08	11.15	0.74	.463
Primary Practice - Social Media Responding	-0.84	-0.01	8.89	-0.09	.925
Primary Practice - Video Calling	7.43	0.21	4.29	1.73	.087
Primary Practice - Voice Calling	-9.80	-0.10	10.51	-0.93	.354

Note.

VSI primary practice is compared to 'Messaging' as the reference group. * indicates significance at the alpha corrected = .017 level, ** indicates significance at the alpha corrected = .003 level, *** indicates significance at the alpha corrected = .0003 level.

Relationship between current happiness and both objective in-person social isolation and virtual social interactions

Using multiple linear regression, we examined how objective in-person social isolation (household size) and virtual social interactions (frequency, number, connection, and primary practice) were associated with participants' ratings of current happiness during COVID-19. There was a significant effect of household size, whereby participants with a higher number of household members reported higher levels of happiness, $b = 22.86$, $t(75) = 3.30$, $p = .001$, 95% CI [9.06, 36.65]. None of the other variables were significantly

Table 2*Current Depression*

	<i>b</i>	beta	<i>SE</i>	<i>t</i>	<i>p</i>
Intercept	2.86	0.00	17.99	0.16	.874
Age	0.70	0.09	0.85	0.83	.411
Sex	-2.29	-0.08	3.14	-0.73	.469
Household Size	-1.76	-0.25	0.78	-2.26	.027
VSI Frequency	1.64	0.22	0.91	1.79	.077
VSI Connection	-1.40	-0.20	0.78	-1.80	.075
VSI Number	1.82	0.27	0.77	2.36	.021
Primary Practice - Social Media Posting	7.55	0.11	7.50	1.01	.317
Primary Practice - Social Media Responding	5.57	0.10	5.98	0.93	.354
Primary Practice - Video Calling	1.81	0.07	2.89	0.63	.533
Primary Practice - Voice Calling	-5.67	-0.08	7.07	-0.80	.425

Note.

VSI primary practice is compared to 'Messaging' as the reference group. * indicates significance at the alpha corrected = .017 level, ** indicates significance at the alpha corrected = .003 level, *** indicates significance at the alpha corrected = .0003 level.

associated with current happiness during COVID-19 when correcting for multiple comparisons (see Table 3).

Discussion

Overall, and in line with prior research, we found evidence to suggest that emerging adults were suffering reduced mental health and changes in social support during the pandemic (Halliburton et al., 2021; Kujawa et al., 2020; Minhas et al., 2021). In our study, there was a large increase in depression, a large decrease in happiness, and a large decrease

Table 3*Current Happiness*

	<i>b</i>	beta	<i>SE</i>	<i>t</i>	<i>p</i>
Intercept	247.56	0.00	166.01	1.49	.140
Age	-6.02	-0.08	7.86	-0.77	.446
Sex	-14.46	-0.06	27.19	-0.53	.597
Household Size	22.86	0.38	6.93	3.30	.001**
VSI Frequency	-9.27	-0.15	8.17	-1.13	.260
VSI Connection	14.66	0.25	7.04	2.08	.041
VSI Number	-2.21	-0.04	6.86	-0.32	.748
Primary Practice - Social Media Posting	-61.97	-0.11	64.80	-0.96	.342
Primary Practice - Social Media Responding	3.84	0.01	60.31	0.06	.949
Primary Practice - Video Calling	-29.36	-0.14	26.05	-1.13	.263
Primary Practice - Voice Calling	71.66	0.13	60.87	1.18	.243

Note.

VSI primary practice is compared to 'Messaging' as the reference group. * indicates significance at the alpha corrected = .017 level, ** indicates significance at the alpha corrected = .003 level, *** indicates significance at the alpha corrected = .0003 level.

in participant ratings of their social needs being met by peers, post-pandemic onset.

Participants also rated their depression as more severe and their happiness as lower than in similar samples collected before the onset of the pandemic. Moreover, feelings of connection from virtual social interactions decreased. However, surprisingly, the level of loneliness in this sample was not different than the level of loneliness reported in other college samples before the COVID-19 pandemic. It is possible that as emerging adults generally, and college students specifically, were already a high loneliness population before the pandemic (Hammond et al., 2018), a ceiling effect was operating in this study in our ability to detect

increased loneliness. Nonetheless, the current data support an effect of the pandemic specifically on emerging adult's mental health, happiness levels, and social satisfaction.

Our hypothesis that frequency of virtual social interactions would be negatively associated with loneliness was not supported. Contrary to expectations, we did not see an association between VSI frequency and loneliness, suggesting that use patterns were not associated with feelings of loneliness. However, we did see an association between objective in-person social isolation and loneliness. Although household size did not change on average across the sample from pre- to post- pandemic onset, those with larger household sizes were less lonely (and were also happier) than those with smaller household sizes amid the pandemic. As over 68% of our sample did not ordinarily live with family but returned home to live with family during the virus outbreak, it is possible that greater household size may have been a proxy for familial support during COVID-19, demonstrating a potential "protective effect" of family for the emerging adults in this study. Similarly, another study found that maternal support in particular was helpful for emerging adults' psychological health (van den Berg et al., 2021).

The fact that we did not see the hypothesized relationship between virtual social interactions and loneliness in this sample is worthy of further exploration, particularly because the direction of the association (although not significant) was in the opposite than expected direction; that is, more frequent virtual social interactions were associated with higher loneliness scores. One possibility for this unexpected non-significant association could be that since loneliness scores were not different from past studies in similar populations (collected before COVID-19), there was no room for improvement in loneliness as a function of VSI in this study. However, the fact that VSI frequency was not significantly associated with either depression or happiness levels, both of which did get worse during COVID-19 (both within this sample, and with reference to prior studies) suggests another explanation. For example, it is possible that those who were less lonely, due to increased household size, sought out VSI less frequently. Therefore, the influence of

VSI on loneliness may depend on household size. In future research it would be interesting to see whether VSI frequency has a moderating role in the association between household size and loneliness.

It is important to also consider the ways that mental health influences the usage (and, thus, the potential effectiveness) of VSI. Individuals who are happy may derive more feelings of connection from VSI and they may use VSI in ways that promote and facilitate social connection. For example, Ping et al. (2020) found that happier individuals used VSI to share information or enhance friendships. Conversely, individuals with lower levels of happiness more often used VSI for entertainment or to avoid loneliness (Holmberg, 2014). Research also supports the idea that VSI can be used in connection-promoting ways (e.g., self-disclosure promoting intimacy and relational closeness; Ledbetter et al., 2011) and non-connection promoting ways (e.g., passive viewing, and social comparison; Clark et al., 2018; Valkenburg et al., 2021). Thus, increasing the quantity of VSI may enhance wellbeing only if the quality of social connection is concurrently increased. In addition, it may be beneficial to conduct qualitative research to identify the ways in which different VSI platforms (e.g., Twitter, Instagram, TikTok, WhatsApp, Facebook, etc.) are used and how their unique features might contribute to feelings of connection (Yeshua-Katz et al., 2021).

Importantly, in this study, we examined only spontaneous usage patterns of VSI, and the vast majority of participants in our sample indicated that messaging/texting was their primary mode of virtual social interaction with friends both before and after the onset of COVID-19. While messaging/texting can be connection-promoting, Kumar and Epley (2021) showed that interactions including voice created stronger social bonds compared to interactions including only text. As such, future studies should look not only at overall frequency of spontaneous usage, but also at frequency of connection promoting usage. It is possible that directed VSI interventions may be more effective in promoting wellbeing than spontaneous VSI usage. Indeed, a recent study investigated an intervention which created virtual “small groups” for social interactions among seniors during

COVID-19 (Shapira et al., 2021) and results indicated that these directed virtual social interactions resulted in reduced loneliness and depression.

Limitations

Our study had several methodological limitations to consider when drawing conclusions from the results. The sample was a relatively small convenience sample and consisted primarily of female university students. Therefore, results may not generalize to the wider population of emerging adults in the United States and abroad. Although it maintains face validity, the questionnaire used to measure virtual social interactions was initially designed for use in adolescents as opposed to emerging adults. The type of practice used for virtual social interactions also likely alters the quality of social interaction, and we were unable to separately examine frequency and feelings of connection for each practice used. Further, our cross-sectional design did not allow us to make strong claims about baseline levels of virtual social interaction, loneliness, depression, and happiness, and instead relied on retrospective reports.

Conclusions

In this study, objective in-person social isolation was associated with lower happiness and higher loneliness, yet we did not find any associations between virtual social interactions and loneliness, depression, or happiness. Much research has been conducted in recent years on virtual communication technologies and their impacts (both positive and negative) on mental health (Ellison et al., 2007; Hall et al., 2021; Hsu et al., 2011; Lou et al., 2012; Parks and Roberts, 1998; Shaw and Gant, 2002; Verduyn et al., 2017; Whitty, 2008). However, although emerging adults spend much time utilizing virtual communication methods, they also typically experience a rich and varied social landscape in-person. While past research has suggested that social media can be beneficial for social interactions (Pew Research Center, 2018), the current crisis has allowed us to examine virtual social interactions at a time in which in-person interactions have been drastically

reduced. More research into the mechanisms underlying feelings of social connection derived from virtual social interaction is warranted.

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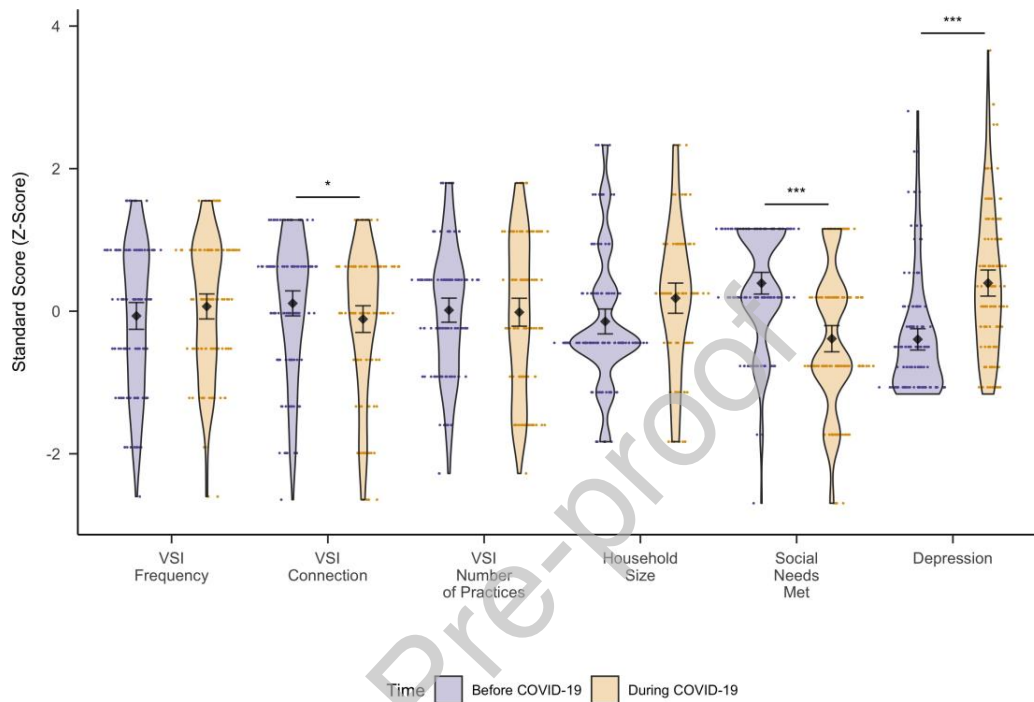


Figure 1

Pre- post-COVID-19 Comparisons

Note. Standardized z-scores for participants on several variables which were assessed currently (during COVID-19) and retrospectively (before COVID-19). Each dot represents an individual participant. The black diamonds represent the mean score of each set of observations and corresponding error bars. Individual dots are jittered horizontally for visibility. The mean comparisons which were significantly different during COVID-19 versus before COVID-19 are indicated with a bar and *, **, or ***. * Indicates a significant difference at the alpha corrected = .008 level. ** Indicates a significant difference at the alpha corrected = .002 level. *** Indicates a significant difference at the alpha corrected = .0002 level.

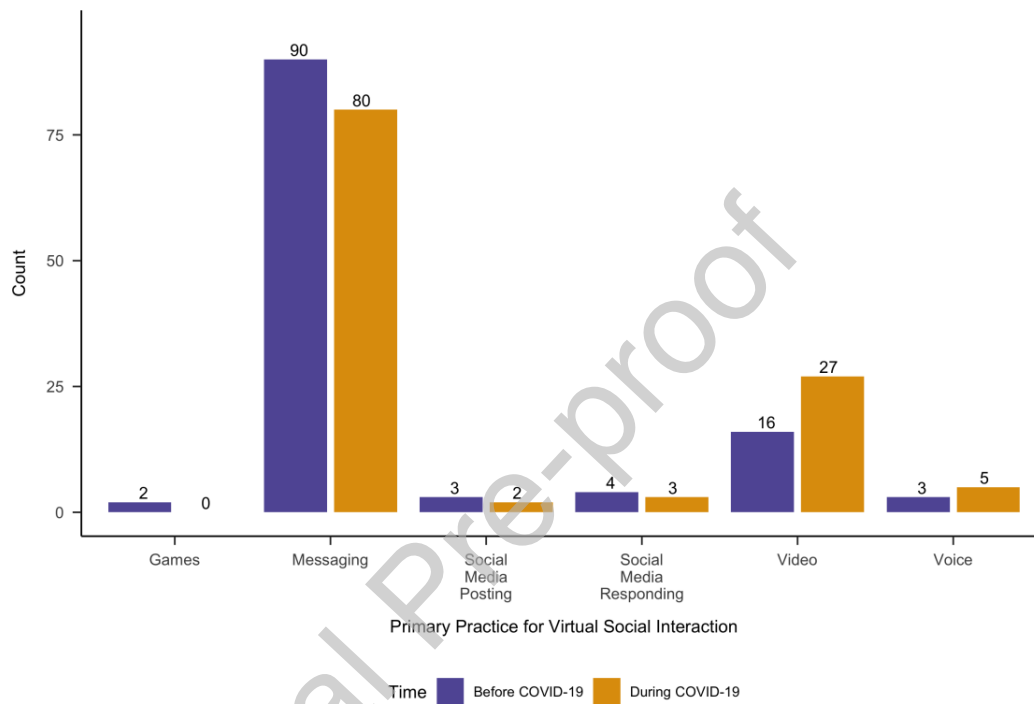


Figure 2

Pre- post-COVID-19 Primary Practice

Note. The bars represent the number of participants who indicated each practice as their primary practice for virtual social interaction with friends before COVID-19 and during COVID-19. Categories were mutually exclusive for each time point. One participant did not respond to the question, two participants indicated their prior but not current primary practice, and one participant indicated their current but not prior primary practice.

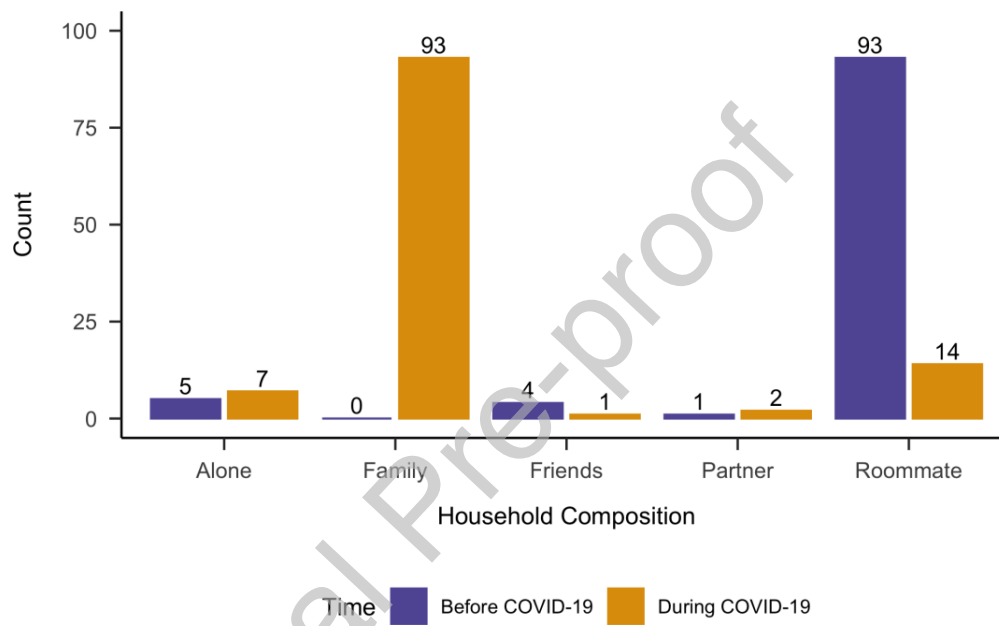


Figure 3

Pre- post-COVID-19 Household Composition

Note. The bars represent the number of participants with each household composition both prior to COVID-19 and during COVID-19. Categories were not mutually exclusive - for example participants may have lived with a partner and roommate and are therefore counted twice.

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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