Supplementary Material to:

Social Affect Regulation in University Students During the COVID-19 Pandemic

In *Collabra: Psychology*

**Deviations From Preregistration**

For Hypotheses 1 and 2, we inadvertently neglected to specify the predicted direction of association in the preregistration, but the effect directions stated for these hypotheses in the main text reflect our a priori predictions. Also, we reordered and divided the hypotheses between the main text and supplementary material with respect to their presentation in the preregistration, but all aspects of all preregistered hypotheses were addressed. Second, the set of categories reported in this article for the free-response coping actions and experiences includes one category (Going Out) in addition to those named in the preregistration. This category was added through consensus of the research team during the coding of the data from the current study. Third, two psychometric questionnaires were collected in addition to those reported and analyzed in this article: the Emotion Regulation Questionnaire (Gross & John, 2003) and the Brief COPE (Carver, 1997). The preregistration implied that all psychometric measures would be analyzed to evaluate Hypothesis S2, but these two were not relevant to this hypothesis because they measure affect regulation tendencies rather than mental health symptoms. Finally, the preregistration simply stated that *p* < .05 would be used as the threshold for significance for all analyses. However, we were advised during the review process to adjust this threshold for multiple testing for the correlation analyses, given the larger number of tests for this set of analyses, which we have done.

**Free-Response Coping Actions and Experiences**

 All coping responses from the Pandemic Coping Questionnaire were coded into categories by two independent raters. Follow-up procedures were used to resolve any discrepancies (details described in the main text). To provide further explanation of the categories listed in Figure 2, responses were coded as *Media* if they involved consuming media (e.g., television, movies, internet videos, music, books, social media). Responses were coded as *Non-Family Social* if they involved actively communicating or interacting with friends, significant others, or intimate partners (i.e., social contacts other than traditional family members). Responses were coded as *Exercise* if they involved any activities traditionally used as forms of exercise (e.g., running, taking walks, going to the gym, dancing) or activities centrally involving moderate-to-high physical activity (e.g., roller-skating). Responses were coded as *Going Out* if they centrally involved doing an activity away from the respondent’s residence (e.g., traveling, going for a drive, going to restaurants, going to parks). Responses were coded as *Mental* if they emphasized mental activity (e.g., thinking about “X,” meditating, praying, journaling, therapy, reflecting on “X”). Responses were coded as *Food* if they centrally involved the making or consumption of food (e.g., baking, cooking, eating, getting food). Responses were coded as *Arts* if they involved the creation of arts or crafts (e.g., painting, drawing, knitting, coloring, making music). Responses were coded as *Family* if they involved actively communicating or interacting with family members. Responses were coded as *Games* if they involved traditional physical games (e.g., card games, board games) or digital games (e.g., computer/online games, console-based video games). Responses were coded as *Pets* if they involved interacting with pets. Finally, responses were coded as *Other* if they had components that did not fall within any of the named categories.

Allowing participants to nominate their most effective coping activities through free response yielded an interesting finding: only three instances explicitly describing reappraisal were nominated. Furthermore, only about one third of participants nominated some mentally focused form of regulation, despite the fact that participants were prompted that responses could include actions or experiences that were either mental or behavioral. One possibility is that students spontaneously use cognitive approaches for affect regulation less frequently than behavioral approaches, and their nominations accurately reflect their preferred affect regulation approaches. Given the evidence on the effectiveness of using strategies such as reappraisal (Gross, 2002; Webb et al., 2012) and meditation (Galante et al., 2014; Goyal et al., 2014) to promote affective health, this finding could indicate that explicit direction or training is needed for most students to derive use and benefit from these strategies (Suri et al., 2015). Another possibility is that students do regularly employ cognitive affect regulation (Gross & John, 2003; Zarotti et al., 2020), but they simply have less awareness of doing so relative to overt behavioral activities; therefore, they did not nominate such activities through free response. In this study, we were specifically interested in examining affect regulation behavior using free response. This approach differs from more common questionnaire (Carver, 1997; Gratz & Roemer, 2004; Gross & John, 2003) or structured-interview approaches (Gross et al., 2006) by assessing respondents’ insight into their affect regulation, without the bias or direction of more specific questions or a list of potential options. This approach does incur the risk that participants might have poor insight into some of their cognitions or behaviors, but we believe this risk was balanced by the value of obtaining authentic self-reports of affect regulation, unconstrained by existing scientific theories and instruments. Within the same survey, these participants did endorse some habitual use of reappraisal on the Emotion Regulation Questionnaire with a mean rating of 4.66 on a scale of 1 (*strongly disagree*) to 4 (*neutral*) to 7 (*strongly agree*). Hopefully, future research will help to explain the source of this apparent inconsistency between questionnaire and free-response reports of reappraisal use, whether it be low awareness of reappraisal use or low perceptions of efficacy.

**Additional Hypotheses Involving Comparisons with a Previous Study**

 Shortly after the beginning of the COVID-19 pandemic, we administered a smaller study with very similar materials and methods to the current study reported in the main text. The current study and its preregistration were developed and implemented to follow up on this previous study. Below, we describe the preregistered hypotheses that involve comparisons between the current and previous studies, and the subsequent analyses and results.

***Hypotheses***

When analyzing the data from the previous study, we had observed that participants reported changes in levels of social interactions since the pandemic began, and participants reported increased levels of mental health symptoms relative to population normative data reported prior to the pandemic (details reported below; as these studies were cross-sectional, we used these comparisons with normative data to roughly estimate whether our data deviated significantly from what might typically be expected). As the current study was collected over a year later, and at a time when pandemic-related restrictions were relaxing, we predicted that effects potentially related to the pandemic, such as these, would have diminished due to habituation and other adaptations (e.g., more developed remote social interaction habits, or returning to more in-person social interactions). Specifically, for Hypothesis S1, we predicted that changes in levels of social interactions since the pandemic began would be smaller in the current study compared to the previous study. For Hypothesis S2, we predicted that mental health symptoms would be lower in the current study compared to the previous study, and mental health symptoms in the current study would no longer differ from the population normative data.

***Participants***

For the previous study, undergraduate students at the University of Denver (*N* = 68) were recruited through a participant pool managed by the Department of Psychology with no additional eligibility criteria assessed. Participants completed this study between April 15 and May 30, 2020, during their spring academic term. Students received course credit for their participation.

After data collection, several exclusion criteria were applied to ensure the quality of the data set (these criteria match those preregistered for the current study). First, data were excluded from participants who exited the survey before completion (*n* = 5). Second, data were excluded from participants who failed one or both attention check items included in the survey (*n* = 13). Third, data were excluded from participants who completed the survey in less than 20 minutes (*n* = 3); based on pilot testing, attentive completion of all survey materials was expected to take approximately 30-60 minutes. Therefore, analyses of this sample were based on a final sample of 47 students. See Table S1 for a summary of demographic characteristics.

**Table S1**

*Demographic Characteristics of Previous Study Sample*

|  |  |
| --- | --- |
| Age | 19.7 ± 1.1 |
| Sex |  |
|  Female | 39 |
|  Male | 8 |
| Gender |  |
|  Man | 8 |
|  Non-binary | 0 |
|  Woman | 39 |
| Race |  |
|  African American | 0 |
|  American Indian or Alaskan Native | 2 |
|  Asian | 2 |
|  Caucasian | 43 |
|  Multiracial | 0 |
|  Native Hawaiian or Pacific Islander | 0 |
| Ethnicity |  |
|  Hispanic/Latinx | 2 |
|  Not Hispanic/Latinx | 45 |

For this previous study, we aimed to recruit as many participants as possible through the noted participant pool during the spring academic term, when quarantine procedures were being implemented in response to the pandemic at the University of Denver. Sensitivity power analyses using G\*Power (version 3.1.9.4; www.psycho.uni-duesseldorf.de/abteilungen/aap/gpower3/) indicated that with the final sample (*N* = 47) we had 80% power to detect an effect size of *d* = 0.42 (i.e., between the conventional values for small [0.2] and medium [0.5]) with alpha of .05 using a two-tailed one-sample *t* test. For an independent-samples *t* test comparing the samples from the current and previous studies, we had the sensitivity to detect an effect size of *d* = 0.47.

***Materials and Analyses***

Participants in the previous study completed a survey with many of the same materials as the survey in the current study, including the PSS, BDI-II, STAI, and the two custom questionnaires. In addition to the free-response coping items described in the main text, the Pandemic Coping Questionnaire included ratings of changes in levels of social interaction since the pandemic via text, voice, video, in-person interaction, physical contact, and overall on a scale of 1 (*much less now*) to 4 (*about the same*) to 7 (*much more now*). These items refer to changes in total levels of social interactions in these communication domains, and they were completed prior to the ratings of communication frequencies for specific social contacts in the Social Network and Reappraisal Questionnaire.

One-sample *t* tests were performed to analyze changes in levels of social interaction against a test value of four (i.e., no change) for the samples of both studies. Independent-samples *t* tests were then used to evaluate Hypothesis S1 by comparing changes in levels of social interaction between the current and previous studies. To evaluate Hypothesis S2, we performed one-sample *t* tests comparing the data from each study to the most relevant population normative data we could find for each psychometric measure, and we performed independent-samples *t* tests directly comparing mental health symptoms between the samples from each study. Outlying data points were excluded from analysis, defined as scores greater than three standard deviations from the mean. The normative data for the PSS were based on a sample of 645 U.S. young adults ages 18-29 (Cohen, 1988). The normative data for the BDI-II were based on a sample of 15,233 U.S. undergraduate students (Whisman & Richardson, 2015). The normative data for the STAI were based on a sample of 855 U.S. undergraduate students (Spielberger et al., 1983). The normative data for the SHAI were based on a combined sample of 225 students and healthy community members (Salkovskis et al., 2002). Larger student or healthy samples were found reporting total scores on the 18-item version of the SHAI, but not the 14-item version we administered.

***Results and Interpretations***

Participants in the previous study reported significant changes in levels of social interaction across all modalities, with decreases in overall (*t*(46) = 6.38, *p* < .001, *d* = 0.93), in-person (*t*(45) = 8.94, *p* < .001, *d* = 1.32), and physical interaction (*t*(46) = 5.71, *p* < .001, *d* = 0.83), and increases in text-based (*t*(46) = 3.57, *p* = .001, *d* = 0.52), voice-based (*t*(46) = 2.06, *p* = .045, *d* = 0.30), and video-based interaction (*t*(46) = 8.77, *p* < .001, *d* = 1.28; Table S2 and Figure S1). Similarly, participants in the current study reported decreased overall (*t*(151) = 11.16, *p* < .001, *d* = 0.91), in-person (*t*(151) = 12.69, *p* < .001, *d* = 1.03), and physical interaction (*t*(151) = 9.54, *p* < .001, *d* = 0.77), and increased text-based (*t*(151) = 5.82, *p* < .001, *d* = 0.47), voice-based (*t*(151) = 4.90, *p* < .001, *d* = 0.40), and video-based interaction (*t*(151) = 9.73, *p* < .001, *d* = 0.79; Table S2 and Figure S1). Independent-samples *t* tests indicated that these changes were smaller in the current study for in-person interactions (*t*(196) = 3.55, *p* < .001, *d* = 0.56) and video-based interactions relative to the previous study (*t*(197) = 2.24, *p* = .026, *d* = 0.38; all other *p*s > .05). These results provide partial support for Hypothesis S1.

**Table S2**

*Score Means and Standard Deviations by Study*

|  |  |  |
| --- | --- | --- |
|  | Previous study  (spring 2020) | Current study  (summer 2021) |
| Change in social interaction |  |  |
| Overall | 2.40 (1.72) | 2.70 (1.43) |
| Text | 4.87 (1.68) | 4.72 (1.53) |
| Voice | 4.45 (1.49) | 4.57 (1.44) |
| Video | 5.72 (1.35) | 5.18 (1.49) |
| In-person | 1.85 (1.63) | 2.67 (1.29) |
| Physical | 2.47 (1.84) | 2.76 (1.60) |
| PSS | 25.07 (2.85) | 21.16 (6.91) |
| BDI-II | 13.83 (7.41) | 14.67 (8.59) |
| STAI-Trait | 52.86 (10.32) | 50.30 (11.80) |
| SHAI | NA | 13.51 (7.44) |

**Figure S1**

*Histograms of Ratings of Changes in Social Interaction Due to the Pandemic*



*Note.* The means of the previous and current study distributions differed for changes in video-based and in-person social interactions. The darker blue color indicates areas of overlap between the two histograms.

Perceived stress was significantly lower in the current study relative to the previous study (*t*(178.91) = 5.58, *p* < .001, *d* = 0.74; Table S2 and Figure S2), indicating partial support for the first component of Hypothesis S2. However, the remaining comparisons between studies (BDI-II, STAI) indicated no significant differences (SHAI was not collected in the previous study, precluding comparison). The latter component of Hypothesis S2 was not supported, as the data from the current study indicated elevated stress (µ = 14.2, *t*(151) = 12.42, *p* < .001, *d* = 1.01), depressive symptoms (µ = 9.14, *t*(150) = 7.91, *p* < .001, *d* = 0.64), general anxiety symptoms (µ = 39.60, *t*(151) = 11.18, *p* < .001, *d* = 0.91), and health anxiety symptoms (µ = 9.5, *t*(151) = 6.65, *p* < .001, *d* = 0.54) relative to the population normative data. These results mirror those from the previous study, in which stress (µ = 14.2, t(45) = 25.88, p < .001, d = 3.82), depressive symptoms (µ = 9.14, t(46) = 4.34, p < .001, d = 0.63), and general anxiety symptoms (µ = 39.60, t(43) = 8.53, p < .001, d = 1.29) were elevated relative to the normative data.

**Figure S2**

*Histograms of Scores on Psychometric Measures*



*Note.* See Table S2 for means and standard deviations for each study. PSS = Perceived Stress Scale; BDI-II = Beck Depression Inventory-II; STAI = State-Trait Anxiety Inventory; SHAI = Short Health Anxiety Inventory.

These findings provide additional context to those reported in the main text. Despite the fact that the current study was collected nearly 1.5 years into the COVID-19 pandemic, it seems that only select social and mental health features may have begun to shift back toward more typical or pre-pandemic levels in this population relative to an early pandemic time point. We observed elevated mental health symptoms in both the current and previous studies relative to normative data. While these findings of increased mental health symptoms are consistent with other reports on the mental health of undergraduates during the pandemic (Chirikov et al., 2020), it is important to recognize that our specific findings could also reflect differences in students’ mental health over time, as some of the normative data we found were reported several decades ago. Students in these studies further reported decreased levels of social interactions overall relative to before the COVID-19 pandemic. These findings may help to explain the mental health symptoms we observed, given that substantial evidence supports that social isolation or feelings of loneliness can be detrimental to mental health (Leigh-Hunt et al., 2017; Rohde et al., 2016; Schwarzer et al., 2014).

**Correlations Between Estimated Changes in Social Reappraisal Support and Mental Health**

**Table S3**

*Correlation Table of Estimated Changes in Social Reappraisal Support and Measures of Mental Health Symptoms*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Estimated Change in Social Reappraisal Support | PSS | BDI-II | STAI | SHAI |
| Overall | *r* | -.182 | -.028 | -.104 | .096 |
|  | uncorrected *p* | .025 | .730 | .202 | .241 |
| Text | *r* | -.162 | -.088 | -.171 | .110 |
|  | uncorrected *p* | .046 | .284 | .035 | .177 |
| Voice | *r* | -.148 | .043 | -.061 | .137 |
|  | uncorrected *p* | .071 | .606 | .457 | .095 |
| Video | *r* | -.149 | -.109 | -.197 | .003 |
|  | uncorrected *p* | .069 | .189 | .016 | .975 |
| In-person | *r* | -.128 | .080 | .000 | .175 |
|  | uncorrected *p* | .116 | .329 | .997 | .031 |

*Note.* With adjustment for multiple testing, the threshold for significance was *r* > .24, *p* < .002. Therefore, none of these results met our corrected threshold for significance. PSS = Perceived Stress Scale; BDI-II = Beck Depression Inventory-II; STAI = State-Trait Anxiety Inventory; SHAI = Short Health Anxiety Inventory.

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