Longitudinal associations of social support, everyday social interactions, and mental health during the COVID-19 pandemic

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Abstract

Main effect models contend that perceived social support benefits mental health in the presence and the absence of stressful events, whereas stress-buffering models contend that perceived social support benefits mental health especially when individuals are facing stressful events. We tested these models of how perceived social support impacts mental health during the COVID-19 pandemic and evaluated whether characteristics of everyday social interactions statistically mediated this association—namely, (a) received support, the visible and deliberate assistance provided by others, and (b) pleasantness, the extent to which an interaction is positive, flows easily, and leads individuals to feel understood and validated. 591 United States adults completed a 3-week ecological momentary assessment protocol sampling characteristics of their everyday social interactions that was used to evaluate between-person average values and within-person daily fluctuations in everyday social interaction characteristics. Global measures of perceived social support and pandemic-related stressors were assessed at baseline. Psychiatric symptoms of depression and anxiety were assessed at baseline, at the end of each day of ecological momentary assessment, and at 3-week follow-up. Consistent with a main effect model, higher baseline perceived social support predicted decreases in psychiatric symptoms at 3-week follow-up ($\beta = -.09, p = .001$). Contrary to a stress-buffering model, we did not find an interaction of pandemic-stressors × perceived social support. The main effect of perceived social support on mental health was mediated by the pleasantness of everyday social interactions.
social interactions, but not by received support in everyday social interactions. We found evidence for both main effects and stress-buffering effects of within-person fluctuations in interaction pleasantness on daily changes in mental health. Results suggest the importance of everyday social interaction characteristics, especially their pleasantness, in linking perceived social support and mental health.

Keywords
Social support, social interactions, ecological momentary assessment, depression, stress, pleasantness, COVID-19

The COVID-19 pandemic has adversely impacted mental health in the United States (Ettman et al., 2020; Khubchandani et al., 2021; Tull et al., 2020; Vindegaard & Benros, 2020). For example, a nationally representative survey conducted during the initial weeks of the pandemic (March 31, 2020 to April 13, 2020) reported that more than half of sampled United States adults reported at least mild depression symptoms (Ettman et al., 2020), while a similar survey conducted in the post-lockdown period (July 2020) estimated prevalence rates of 39% for depression symptoms and 43% for anxiety symptoms (Khubchandani et al., 2021). Most recently, the Center for Disease Control (Vahratian et al., 2021) reported that depression and anxiety symptom prevalence among United States adults increased from 36.4% in August 2020 to 41.5% in February 2021. Pandemic-related increases in psychiatric symptoms represent a severe, enduring, and prevalent threat to public health and well-being. Thus, it is important to identify resilience factors that promote mental health during the COVID-19 pandemic.

Theories of social support and mental health

Humans are driven by a fundamental need for social connection, that is, perceiving that one belongs in a social network and can rely on others for support (Baumeister & Leary, 1995; Cohen & Wills, 1985). Measures of perceived social support are broadly and robustly associated with better mental health across the lifespan (Lakey & Orehek, 2011). Moreover, it is likely that social support has assumed increased importance during the COVID-19 pandemic, given that nationwide social distancing practices have radically shifted the number and nature of individuals’ everyday social interactions.

Social support researchers have developed two types of models to explain the observed beneficial effect of social support on mental health (Cohen, 2004; Cohen & Wills, 1985; Feeney & Collins, 2015; Lakey & Orehek, 2011; Thoits, 2011; Uchino et al., 2012).

Main effect models contend that social support benefits mental health by helping individuals to optimally regulate their affect in both the presence and the absence of stressful events. Lakey and Orehek’s Relational Regulation Theory (2011) asserts that the mental health benefits of social support are rooted in positive characteristics of everyday social interactions, including interactions that are centered on positive or mundane events (e.g., capitalization; Gable et al., 2004), routine interactions that are not centered on a
specific event, and interactions that involve the visible and deliberate exchange of support centered on a specific stressor.

Stress-buffering models contend that social support benefits mental health most when individuals are facing stressful events. Stress-buffering theories assert that social support benefits mental health by influencing how individuals appraise potentially stressful events, by facilitating effective coping with life stressors, and by reducing the negative impact of stressful events on mental health. Evidence for a stress-buffering model is observed when stress is more strongly associated with poor mental health among individuals with lower (vs. higher) perceived social support (Cohen & Wills, 1985).

Earlier studies of social support and mental health have reported evidence for both main effects (Lakey & Cronin, 2008) and stress-buffering effects (Brown & Harris, 1978). However, systematic reviews of this literature have found that main effects of social support on mental health are highly replicable across studies and contexts, whereas stress-buffering effects of social support are observed less consistently (Lakey & Orehek, 2011).

Everyday social interactions as a mechanism linking social support and mental health

Both main effect models and stress-buffering models argue that the mental health benefits of perceived social support are rooted in characteristics of everyday social interactions (Cohen & Wills, 1985; Feeney & Collins, 2015; Lakey & Orehek, 2011; Thoits, 2011). Main effect models posit that the mental health benefits of perceived social support are attributable to universal characteristics of everyday social interactions (i.e., interactions that are centered on positive events, neutral events, negative events, or no specific event). The pleasantness of everyday social interactions may provide direct psychological benefits that are independent of stress, such as assisting individuals with regulating their cognition, behavior, and affect (Feeney & Collins, 2015; Lakey & Orehek, 2011; Thoits, 2011). For example, Cohen and Wills (1985) argue that the main effects of social support on mental health are driven by “regular positive experiences” that provide individuals with positive affect and a sense of predictability and stability. Pleasant interactions could also plausibly promote mental health by leading individuals to feel as though their genuine self is seen, understood, and accepted by others (Reis et al., 2004). In turn, this may promote mental health by providing individuals with a sense of social connection that fulfills their need to belong (Baumeister & Leary, 1995).

Stress-buffering models posit that the mental health benefits of perceived social support are attributable to everyday social interactions involving visible and deliberate received support from others in response to specific negative life events. In theory, measures of perceived support reflect the amount of social support a person has received from others in the past and the actual amount of support that will be available to them in the future in their daily lives (Barrera, 1986; Eagle et al., 2019). Received support consists of the diverse types of assistance provided by others, which may include sharing personal feelings, expressing care and concern, offering feedback, or providing tangible help with an errand or task. Received support is thought to promote mental health, in part, by increasing individuals’ perceived efficacy for handling potentially stressful events (Cohen
Earlier research has demonstrated that measures of received support are related to, but distinguishable from, measures of global perceived social support (Haber et al., 2007; Melrose et al., 2015). Global measures of perceived support are relatively stable over time, whereas measures of received support are expected to vary over time and between social interactions. Moreover, measures of received support are only inconsistently associated with better mental health, with some studies even reporting a harmful effect of received support on mental health (Bolger & Amarel, 2007). Social support researchers theorize that the apparent harmful effects of received support may be attributable to the fact that received support is more frequent during times of stress (i.e., confounded with stress) and to the fact that some received support may be unwanted and/or ineffective.

Current investigation

Social support is a candidate resilience factor that could promote mental health among United States adults during the COVID-19 pandemic. Aim 1 of this investigation was to evaluate the impact of perceived social support on mental health during the COVID-19 pandemic in a nationwide sample of United States adults, and to test whether this association was more consistent with a main effect model or a stress-buffering model. Main effect models predict that perceived social support will promote better mental health independent of stressful events (Hypothesis 1a); stress-buffering models predict that perceived social support will protect individuals against declines in mental health and that these benefits will be stronger among respondents with stressful life events (Hypothesis 1b). Perceived social support was measured at baseline. Mental health symptoms were measured at baseline and 3-week follow-up.

Aim 2 of this investigation was to identify characteristics of everyday social interactions that mediated the association of perceived social support and mental health during the COVID-19 pandemic. Specifically, we tested whether the average amount of received support in everyday social interactions (Hypothesis 2a) and the pleasantness of everyday social interactions (Hypothesis 2b) mediated the association of perceived social support and mental health during the COVID-19 pandemic. Characteristics of everyday social interactions were repeatedly measured on each of 21 days.

Analyses of within-person fluctuations in everyday social interaction characteristics and mental health eliminate the influence of between-person confounds (e.g., demographic and personality characteristics) and therefore provide a more stringent test of whether everyday social interaction characteristics are causally associated with changes in mental health (Hoffman & Stawski, 2009). Aim 3 of this investigation was to evaluate the potential main effects and stress-buffering effects of within-person daily fluctuations in everyday social interaction characteristics (i.e., deviations from a respondent’s average value) on daily changes in mental health during the COVID-19 pandemic. Specifically, we tested whether daily fluctuations in pleasantness and received support were associated with daily changes in psychiatric symptoms, and whether daily fluctuations in pleasantness and received support moderated the impact of pandemic-related stressors on daily changes in psychiatric symptom. We also examined other secondary everyday social
interaction characteristics (i.e., interaction frequency, interaction length, interaction modality, and whether the interaction involved a close partner) as covariates in these analyses. Daily psychiatric symptoms were repeatedly measured on each of 21 days.

**Method**

**Participants and procedure**

Respondents were community adults recruited for a study of social interactions and well-being during the coronavirus pandemic. A professional recruitment service (Ipsos) was used to obtain a nationwide geographically-representative panel of individuals residing in the United States who had access to electronic communication and were willing to participate in survey research. There were no exclusionary criteria for this study. Study protocols were approved by the XXXXX University Institution Review Board. This study was not preregistered.

Data were collected between June 30, 2020 and September 3, 2020. Each respondent completed several phases of data collection. At prescreen, respondents provided informed consent and completed demographic questionnaires. At Time 1, respondents completed questionnaires pertaining to their psychiatric symptoms and pandemic-related stressors. During the following 21-day ambulatory monitoring period, respondents completed brief signal-prompted ecological momentary assessments (EMA) of their social interactions and diary assessments of their daily psychiatric symptoms on each day. EMA surveys were prompted eight times per day during random intervals from 8a.m. to 10p.m. Surveys were delivered via text message or email that provided a link to a Qualtrics survey. Respondents were asked to complete at least six of these eight surveys each day. Following this 21-day period (at Time 2), respondents again completed the Time 1 psychiatric symptoms questionnaires. Finally, respondents were debriefed and compensated up to 75 USD for their participation based on their number of completed EMA surveys.

The initial panel consisted of 836 respondents based on budgeted cost. The final sample consisted of 591 respondents. We included in the final sample only those panel members who completed the Time 1 and Time 2 surveys, who completed at least one diary assessment of their daily psychiatric symptoms, who completed at least one EMA survey, and who reported having at least one recent (i.e., occurring within 30 minutes of the EMA survey) social interaction during the ambulatory assessment period. We excluded 245 respondents who did not complete the survey at Time 2, who did not complete at least one daily diary assessment, who did not complete at least one EMA survey, or who did not report having at least one recent social interaction during the ambulatory assessment period. Respondents included in the final sample were older than those excluded, $t(834) = -3.75, p < .001$, and reported fewer psychiatric symptoms at Time 1, $t (834) = 2.00, p = .046$, but did not differ in sex, race, geographic location, employment status, marital status, household size, perceived social support, or pandemic-related stressors.

Mean age of the final sample was 49 years ($SD = 15$, range = 18–85). 60% of respondents identified as female and 40% of respondents identified as male. 79% of respondents were White, 9% of respondents were Black, 5.8% of respondents were Asian,
and 6.4% of respondents were another race/ethnicity. 58% of respondents were employed full-time or part-time, and 42% of respondents were unemployed. 39% of the sample lived in the South, 22% of the sample lived in the Midwest, 21% of the sample lived in the West, and 18% lived in the Northeast. Other demographic characteristics of the final sample are described in Table 1.

We used G*Power 3.1 to conduct a post hoc analysis of achieved power for a linear multiple regression (fixed model, $R^2$ increase) with a sample size of $N = 591$ in a two-tailed test with one predictor, one covariate, and an $\alpha$ error probability of .05 (based on the parameters for our analysis of prospective change). This study had 93% power to detect a small effect ($f^2 = .02$) and >99% power to detect a medium effect ($f^2 = .15$).

| Table 1. Summary of respondent characteristics ($N = 591$). |
|-------------------------------------------------------------|
| **Mean (SD) or %** | **Range** |
| **Age (years)** | 48.7 (15.1) | 18–85 |
| **Sex** | | |
| Female | 60.2% | | |
| Male | 39.8% | | |
| **Race** | | |
| White | 79.2% | | |
| Black | 9.1% | | |
| Asian | 5.8% | | |
| Other | 6.4% | | |
| **Geographical region** | | |
| South | 38.7% | | |
| Midwest | 22.2% | | |
| West | 21.2% | | |
| Northeast | 17.9% | | |
| **Employment status** | | |
| Full- or part-time | 57.9% | | |
| Unemployed | 42.1% | | |
| **Marital status** | | |
| Currently married | 52.8% | | |
| Not currently married | 47.2% | | |
| Living alone | 13.9% | | |
| **Mobility outside home (county-level)** | 0.04 (0.00) | 0–1 |
| **Perceived social support** | 41.68 (6.56) | 12–60 |
| **Pandemic-related stressors** | 1.7 (0.5) | 1–4 |

*Geographic region was defined according to the United States Census regions.

*Mobility outside the home was assessed as the proportion of individuals in a participant’s county who spent more than 6 hours outside the home per day during the study period.

*Perceived social support was assessed using the 12-item Interpersonal Support Evaluation List.

*Pandemic-related stressors were assessed using a 10-item adaptation of the Coronavirus Impact Scale.
Measure

Perceived social support. The 12-item version of the Interpersonal Support Evaluation List (Cohen et al., 1985) was used to assess the global perceived availability of social support in an individual’s life (e.g., “When I need suggestions on how to deal with a personal problem, I know someone I can turn to”) with items rated on a four-point scale and summed to create a composite variable (α = .82).

Psychiatric symptoms. The 10-item Center for Epidemiological Studies Depression Scale (CES-D; Andresen et al., 1994) was used to assess frequency of depressive symptoms during the past week (e.g., “I felt that everything I did was an effort”) rated on a four-point scale (Time 1: α = .89; Time 2: α = .90).

The 7-item Generalized Anxiety Disorders Scale (GAD-7; Spitzer et al., 2006) was used to assess frequency of general anxiety symptoms during the last 2 weeks (e.g., “Worrying too much about different things”) rated on a four-point scale (Time 1: α = .93; Time 2: α = .93).

We conducted a principal components analysis to examine whether scores on the CESD-10 and GAD-7 could be represented by a single factor. We found that scores on the CESD-10 and GAD-7 loaded onto a single factor that accounted for 92.8% of the variance in these scales at Time 1 and 92.2% of the variance in these scales at Time 2. To reduce the number of analyses and the likelihood of Type I error, we calculated a composite variable representing overall psychiatric symptoms by averaging the standardized z-scores for depressive and anxiety symptoms. We examined this composite variable in primary analyses (Time 1: α = .91; Time 2: α = .90).

Pandemic-related stressors. A 10-item adaptation of the Coronavirus Impact Scale (Stoddard & Kaufman, 2020) was used to assess the severity of pandemic-related change across various domains of life – routines, income/employment, food access, medical health care access, mental health treatment access, stress and discord in the family, personal diagnosis of COVID, immediate family members diagnosed with COVID, extended family members or close friends diagnosed with COVID, and general experiences of distress related to the pandemic. Each item was rated from 1 (e.g., no change in routines) to 4 (e.g., severe change in routines). We calculated a composite variable representing individuals’ average extent of pandemic-related change in routine across these life domains.

Everyday social interactions. During each signal-prompted EMA survey, respondents were asked to indicate in how many social interactions they had participated during the last 2 hours and to describe characteristics of their most recent social interaction. A social interaction was defined for respondents as a give-and-take exchange involving two or more people responding to each other and occurring in any modality, including in-person, telephone, video call, text message, email, and social media. We assessed interaction characteristics based on EMA surveys where a participant reported having one or more social interactions within a half-hour of assessment; this interval was intended to reduce
the influence of recall biases on ratings of social interaction characteristics. Respondents were asked to characterize their most recent interaction using a 19-item questionnaire that was derived from previously validated measures of interaction characteristics including Reis et al.’s Rochester Interaction Record (Reis & Wheeler, 1991), and Kamarck et al.’s Diary of Ambulatory Behavioral States. Each item was rated using a sliding scale from 0 (No) to 10 (Yes) with the default response set to 5. For the purposes of this investigation, we used the 19-item questionnaire to create composite variables representing received support and pleasantness using the unweighted mean of subscale items shown in Table 2 (see the online supplementary material for a principal component analysis of the full 19-item questionnaire, which provides evidence that received support and pleasantness were distinct but correlated).

Received support was assessed using a seven-item composite measure ($\alpha = .90$ across all EMA surveys with a recent social interaction) of the extent to which respondents received visible and deliberate support from others in their most recent social interaction: (1) “Someone expressed care/concern for you,” (2) “Someone provided you helpful information,” (3) “Someone did you a favor,” (4) “Someone helped you with an errand/task,” (5) “Someone expressed confidence in you,” (6) “Someone expressed care/concern for you,” and (7) “Someone gave you positive feedback.” These items have been previously used to assess instrumental support and emotional support in EMA studies of social interactions (e.g., Vella et al., 2008).

Pleasantness was assessed using a six-item composite measure ($\alpha = .95$ across all EMA surveys with a recent social interaction) of the extent to which respondents

| Item                                                                 |
|---------------------------------------------------------------------|
| **Received support**                                                |
| 1. Someone shared personal feelings with you                        |
| 2. Someone provided you helpful information                         |
| 3. Someone did you a favor                                          |
| 4. Someone helped you with an errand/task                            |
| 5. Someone expressed confidence in you                              |
| 6. Someone expressed care/concern for you                           |
| 7. Someone gave you positive feedback                              |
| **Pleasantness**                                                    |
| 1. This was a pleasant interaction                                  |
| 2. Conversation flowed easily                                       |
| 3. This was an agreeable interaction                                |
| 4. We shared common interests and values                            |
| 5. This was a meaningful interaction                                |
| 6. You felt understood and appreciated                             |

Note. Respondents were instructed to indicate the extent to which each item was descriptive of their most recent social interaction. Items were rated using a sliding scale from 0 (No) to 10 (Yes) with the default response set to 5.
evaluated their most recent social interaction positively: (1) “This was a pleasant interaction,” (2) “Conversation flowed easily,” (3) “This was an agreeable interaction,” (4) “We shared common interests and values,” (5) “This was a meaningful interaction,” and (6) “You felt understood and appreciated.” These items were selected because of their common factor loading (see the online supplementary material).

*Interaction length* was assessed using a single item that asked respondents to indicate how long their most recent social interaction lasted on a five-point scale: 1 = <1 minute, 2 = 1–10 minutes, 3 = 11–20 minutes, 4 = 21–60 minutes, 5 = >60 minutes.

*Interaction modality* was assessed using a single item that asked respondents to indicate whether their most recent social interaction occurred *in-person* or occurred via another modality (i.e., phone/voice call, video call, text, email, or social media).

*Close ties* were assessed at baseline. Respondents were asked to list up to five close partners, including three with whom they enjoyed socializing and two with whom they felt comfortable discussing important matters. We assessed whether each interaction involved a close partner by asking respondents to select from a drop-down list which, if any, of these close partners were involved.

*Interaction frequency* was assessed by dividing the number of EMA surveys with a recent social interaction by the total number of completed EMA surveys.

We calculated *between-person average values* for each of these everyday social interaction characteristics for each participant across all completed EMA surveys with a recent social interaction (i.e., aggregated to the person-level). We calculated *within-person daily fluctuations* in everyday social interaction characteristics by subtracting respondents’ between-person average value from their raw daily score (i.e., aggregated to the day-level).

**Daily psychiatric symptoms.** Daily psychiatric symptoms were assessed via diary survey at the end of each assessment day using a four-item composite that was intended to capture the frequency and intensity of depressive symptoms (“Little interest or pleasure in doing things” and “Feeling down, depressed, or hopeless”) and anxiety symptoms (“Feeling nervous, anxious, or on edge” and “Not being able to stop or control worrying”) during that day rated on a five-point scale ($\alpha = .91$ for the four-item scale across all end-of-day diary surveys). Anxiety symptom items were from the 2-item version of the Generalized Anxiety Disorder scale (Kroenke et al., 2007). Depression symptom items were from the 2-item Patient Health Questionnaire (Kroenke et al., 2003).

**Covariates.** Primary covariates were selected a priori because of their potential associations with perceived social support, everyday social interactions, and psychiatric symptoms. These covariates were self-reported age (continuous), sex (male/female), race (White/Black/Asian/other), employment status (employed/unemployed), marital status (married/unmarried), living arrangement (alone/not alone), and location in the United States (Northeast/Midwest/South/West). We combined location data with publicly available COVID indicator data (Farrow et al., 2015) to assess mobility outside the home in a participant’s county during the study period, as indicated by the proportion of mobile devices that spent more than 6 hours per day in a location other than the home.
These aggregate mobility data were averaged across the assessment period and used as a marker of local shelter-in-place policies active during the period of assessment in each location.

Data analysis

We tested Aim 1 using covariate-adjusted linear regression models evaluating whether the global measure of perceived social support at baseline was associated with 3-week changes in psychiatric symptoms, and whether this association was moderated by pandemic-related stressors.

We tested Aim 2 using covariate-adjusted linear regression models evaluating whether respondents’ average levels of everyday social interaction characteristics were associated with baseline perceived social support and 3-week changes in psychiatric symptoms. Analyses of indirect effects were conducted for everyday social interaction characteristics that were associated with both perceived social support and changes in psychiatric symptoms in covariate-adjusted models. Specifically, the PROCESS macro for SPSS (Version 3.5) was used to test the strength and significance of each hypothesized indirect effect, with adjustment for covariates, using bias-corrected bootstrapping with 10,000 resamples (Hayes, 2018).

We tested Aim 3 using two-level multilevel models nesting assessment days (Level 1) within respondents (Level 2) to evaluate the associations of within-person fluctuations in everyday social interaction characteristics and daily changes in psychiatric symptoms, and to test whether this association was moderated by pandemic-related stressors. Multilevel model syntax is displayed in the online appendix. Models were fit using Stata’s mixed command with restricted maximum likelihood estimation and with an unstructured covariance matrix. Models included a random intercept for respondent and random effects for yesterday’s psychiatric symptoms and day of assessment (coded continuously as number of days since study entry; range = 0–21).

Results

Descriptive analysis

The final sample of 591 respondents completed 71,525 EMA surveys, with a mean completion rate of 71.5% (median = 80.4%, range = 2–100%). Respondents reported a social interaction occurring within the last 30 minutes in 54% of their EMA surveys. Seventy-three percent of interactions occurred in-person, 63% involved a close partner, and the mean interaction length was 11–20 minutes (M = 2.9, SD = 0.7). On average, interactions were rated 7.1 (SD = 2.8) out of 10 in pleasantness and 4.5 (SD = 2.1) out of 10 in received support. Ratings of pleasantness and received support were normally distributed with skewness and kurtosis values <1.2.

Mean CESD-10 scores declined from Time 1 (M = 9.3, SD = 7.0) to Time 2 (M = 8.0, SD = 6.9), t (590) = 6.55, p < .001. Scores on the CESD-10 exceeded the clinical cutoff value of ≥10 for 43.1% of respondents at Time 1 and 36.7% of respondents at Time 2.
Mean GAD-7 scores declined from Time 1 ($M = 6.1, SD = 5.6$) to Time 2 ($M = 4.8, SD = 5.5$), $t (590) = 7.90, p < .001$. Scores on the GAD-7 exceeded the cutoff value of $\geq 5$ for mild anxiety for 52.3% of respondents at Time 1 and 40.4% of respondents at Time 2.

Mean daily psychiatric symptom score across respondents was 0.7 (SD = 0.8) on a scale ranging from 0 to 4.

**Aim 1: Perceived social support and 3-week changes in mental health**

Table 3 shows the results of linear regression models testing the main effect (Model 2) and the stress-buffering effect (Model 3) of perceived social support in predicting psychiatric symptom change from Time 1 to Time 2.

Consistent with the main effect model (Hypothesis 1a), higher levels of global perceived social support predicted declines in psychiatric symptoms from Time 1 to Time 2, $\beta = -0.09, SE = 0.00, p = .001$. Perceived social support accounted for a significant proportion...
of the variance in psychiatric symptom change from Time 1 to Time 2, $R^2$ change = .01, $F(1,575) = 10.52, p = .001$. Unexpectedly, pandemic-related stressors did not predict changes in psychiatric symptoms at Time 2 in a covariate-adjusted model ($\beta = .01, SE = .05, p = .77$).

Contrary to the stress buffering model (Hypothesis 1b), we did not find evidence for a stress-buffering effect of perceived social support in predicting changes in psychiatric symptoms at Time 2. Pandemic-related stressors were not associated with changes in psychiatric symptoms at one standard deviation below ($B = -.05, SE = .06, p = .41$) or above ($B = .08, SE = .06, p = .18$) the mean level of perceived social support.

Follow-up analyses of 3-week changes in mental health that examined the main effects of perceived social support: (i) with additional covariates for personality traits, (ii) with raw changes in depression and anxiety symptoms as outcome variables, and (iii) with demographic variables as moderators are presented in the online supplement. These analyses show that the main effect of perceived social support on psychiatric symptoms persisted when controlling for personality traits, and that this association was potentially moderated by race (but not by other demographic characteristics).

**Aim 2: Testing for mediation by average everyday social interaction characteristics**

To test whether the effects of perceived social support were mediated by characteristics of everyday social interactions, we first examined whether perceived social support was associated with between-person average values of everyday social interaction characteristics in covariate-adjusted models. Higher levels of perceived social support at Time 1 predicted higher average ratings of received support ($\beta = .11, p = .006$) and pleasantness ($\beta = .25, p < .001$) in everyday social interactions, but did not predict the frequency of interaction ($\beta = .05, p = .21$), the proportion of interactions involving a close partner ($\beta = .07, p = .09$), the proportion of interactions occurring in-person ($\beta = .01, p = .73$), or the mean interaction length ($\beta = .05, p = .25$).

Next, we examined whether between-person average everyday social interaction characteristics were associated with declines in psychiatric symptoms in covariate-adjusted models. Higher levels of pleasantness ($\beta = -.09, p = .001$) and a higher proportion of interactions occurring in-person ($\beta = -.08, p = .005$) predicted declines in psychiatric symptoms at Time 2. Higher levels of received support were associated with marginally significant declines in psychiatric symptoms ($\beta = -.05, p = .054$). However, average values of other interaction characteristics were not associated with changes in psychiatric symptoms at Time 2, including interaction frequency ($\beta = -.03, p = .23$), interaction length ($\beta = .01, p = .75$), and the proportion of interactions involving a close partner ($\beta = -.03, p = .30$).

Based on the results of these analyses, we conducted planned mediation analyses testing whether the observed main effect of perceived social support on psychiatric symptoms was mediated by average ratings of received support (Hypothesis 2a) or average ratings of pleasantness (Hypothesis 2b) in everyday social interactions. Results are summarized in Figure 1. Consistent with Hypothesis 2b, higher average ratings of pleasantness in everyday social interactions mediated the association between perceived
social support and psychiatric symptoms, $\beta = .02$, 95% CI = [-.03, -.00]. However, Hypothesis 2a was not supported; average ratings of received support in everyday social interactions did not mediate the association of perceived social support and psychiatric symptoms, $\beta = .01$, 95% CI = [-.01, .00]. Because average ratings of pleasantness and received support were moderately correlated ($r = .59$, $p < .001$), we tested pleasantness and received support as mediators of the effect of perceived support on psychiatric symptoms in the same model. In this analysis, we again found evidence for a mediating effect of pleasantness, $\beta = .02$, 95% CI = [-.04, -.00], but not received support, $\beta = .00$, 95% CI = [-.01, .01].

**Aim 3: Daily fluctuations in everyday social interaction characteristics and daily changes in mental health**

Table 4 summarizes the results of multilevel models testing the main effect of within-person daily fluctuations in everyday social interaction characteristics (i.e., deviations from a respondent’s average value) on daily changes in psychiatric symptoms (i.e., controlling for yesterday’s psychiatric symptoms). Daily fluctuations in pleasantness ($B = -.04$, $SE = .00$, $p < .001$) and in received support ($B = -.01$, $SE = .00$, $p = .001$) predicted decreases in daily psychiatric symptoms. However, daily fluctuations in other interaction characteristics were not associated with changes in daily psychiatric symptoms, including...
fluctuations in interaction length ($B = -.01, SE = .01, p = .09$), in the proportion of interactions involving a close partner ($B = -.04, SE = .02, p = .06$), in interaction frequency ($B = -.02, SE = .03, p = .47$), and in the proportion of interactions occurring in-person ($B = -.02, SE = .02, p = .48$).

We also tested the stress-buffering effect of within-person fluctuations in everyday social interaction characteristics on daily psychiatric symptom changes (i.e., buffering the impact of pandemic-related stressors). In separate models, we found evidence for stress-buffering effects of within-person fluctuations in pleasantness ($B = -.03, SE = .01, p = .001$) and received support ($B = -.03, SE = .01, p = .003$). We found no evidence for a stress-buffering effect of fluctuations in interaction frequency ($B = -.02, SE = .08, p = .75$), interaction length ($B = -.01, SE = .02, p = .45$), the proportion of interactions occurring in-person ($B = .09, SE = .05, p = .09$), or the proportion of interactions involving a close partner ($B = .02, SE = .05, p = .70$).

Because daily fluctuations in pleasantness and daily fluctuations in received support were moderately correlated ($r = .59, p < .001$), we tested whether the main effects of daily fluctuations in pleasantness and daily fluctuations in received support on daily psychiatric symptoms persisted when examined in the same model. In this model, daily fluctuations in pleasantness remained associated with decreases in daily psychiatric symptoms when accounting for fluctuations in received support ($B = -.05, SE = .01, p < .001$); in contrast, daily fluctuations in received support were associated with increases in daily psychiatric symptoms when accounting for fluctuations in pleasantness ($B = .01, SE = .00, p = .004$).

We also tested whether the stress-buffering effects of daily fluctuations in pleasantness and received support persisted when examined in the same model. When tested in the same model, we found a stress-buffering effect of within-person fluctuations in pleasantness on daily psychiatric symptom changes ($B = -.04, SE = .01, p = .003$; see Figure 2(a)), but no evidence for a stress-buffering effect of within-person fluctuations in received support on daily psychiatric symptom changes ($B = .00, SE = .01, p = .67$; see Figure 2(b)).

Follow-up analyses that examined the indirect effect of perceived social support (predictor) on daily mental health (outcome) mediated by daily (average) values of everyday social interaction characteristics (mediator) are presented in the online supplement. These analyses found an indirect effect of perceived social support on daily psychiatric symptoms mediated by daily ratings of pleasantness, and a smaller indirect effect of perceived support on daily psychiatric symptoms mediated by daily ratings of received support.

**Discussion**

This study of United States adults tested two theories of how perceived social support benefits mental health during the COVID-19 pandemic (Aim 1). Mean depression and anxiety symptom scores in this study were slightly below previously suggested clinical cutoff values (Andresen et al., 1994; Johnson et al., 2019; Spitzer et al., 2006), and were comparable to those reported by other studies of United States adults that were conducted between March 2020 and May 2020 (e.g., Fitzpatrick et al., 2020; Gierc et al., 2021).
| (a) Pleasantness | Model 1 | Model 2 |
|------------------|---------|---------|
|                  | B (SE) P | B (SE) P |
| Yesterday's psychiatric symptoms | .24 (.02) <.001 | .24 (.02) <.001 |
| Day of assessment | .00 (.00) .61 | .00 (.00) .59 |
| Pandemic-related stressors | .58 (.05) <.001 | .58 (.05) <.001 |
| Pleasantness (between-person averages) | -.08 (.01) <.001 | -.08 (.01) <.001 |
| Pleasantness (within-person fluctuations) | -.04 (.00) <.001 | .01 (.02) .50 |
| Pleasantness (within-person fluctuations) × stressors | | -.03 (.01) .001 |
| Log restricted-likelihood | -6068.53 | -6066.95 |

| (b) Received support | Model 1 | Model 2 |
|----------------------|---------|---------|
|                      | B (SE) P | B (SE) P |
| Yesterday's psychiatric symptoms | .25 (.02) <.001 | .25 (.02) <.001 |
| Day of assessment | .00 (.00) .81 | .00 (.00) .84 |
| Pandemic-related stressors | .60 (.05) <.001 | .60 (.05) <.001 |
| Received support (between-person averages) | -.01 (.01) .44 | -.01 (.01) .44 |
| Received support (within-person fluctuations) | -.01 (.00) .001 | .03 (.02) .042 |
| Received support (within-person fluctuations) × stressors | | -.03 (.01) .003 |
| Log restricted-likelihood | -6137.35 | -6136.76 |

| (c) Interaction length | Model 1 | Model 2 |
|------------------------|---------|---------|
|                       | B (SE) P | B (SE) P |
| Yesterday's psychiatric symptoms | .25 (.02) <.001 | .25 (.02) <.001 |
| Day of assessment | -.00 (.00) .96 | -.00 (.00) .97 |
| Pandemic-related stressors | .63 (.05) <.001 | .63 (.05) <.001 |
| Interaction length (between-person averages) | -.12 (.04) .001 | -.12 (.04) .001 |
| Interaction length (within-person fluctuations) | -.01 (.01) .12 | .02 (.03) .54 |
| Interaction length (within-person fluctuations) × stressors | | -.02 (.02) .30 |
| Log restricted-likelihood | -6134.16 | -6136.90 |

| (d) Interactions involving close partner(s) | Model 1 | Model 2 |
|------------------------------------------|---------|---------|
|                                       | B (SE) P | B (SE) P |
| Yesterday's psychiatric symptoms | .25 (.02) <.001 | .25 (.02) <.001 |
| Day of assessment | -.00 (.00) .92 | -.00 (.00) .92 |
| Pandemic-related stressors | .59 (.05) <.001 | .59 (.05) <.001 |
| Interactions involving close partner(s) (between-person averages) | .07 (.08) .35 | .07 (.08) .35 |
| Interactions involving close partner(s) (within-person fluctuations) | -.04 (.02) .06 | -.08 (.09) .36 |
| Interactions involving close partner(s) (within-person fluctuations) × stressors | | .02 (.05) .63 |
| Log restricted-likelihood | -6138.04 | -6139.99 |

(continued)
Consistent with a main effect model, we found that adults with higher perceived social support at baseline reported decreases in psychiatric symptoms at 3-week follow-up. In contrast, we did not find evidence for a stress-buffering effect of perceived social support (i.e., no interaction of perceived social support × pandemic-related stressors) on changes in psychiatric symptoms at 3-week follow-up. These results are consistent with studies of perceived social support and mental health in non-pandemic contexts, which have found consistent evidence for a main effect of perceived social support on mental health (Lakey & Orehek, 2011), but less consistent evidence for a stress-buffering effect of perceived social support on mental health (Cohen & McKay, 1984; Cohen & Wills, 1985).

This study also aimed to identify characteristics of everyday social interactions that accounted for the positive impact of perceived social support on mental health (Aim 2). We found that the association of perceived social support and changes in mental health was mediated by average ratings of pleasantness in everyday social interactions, but not by average ratings of received support in everyday social interactions. These results are consistent with assertions by Thoits (2011) and by Relational Regulation Theory (Lakey & Orehek, 2011) that the benefits of perceived social support on mental health are attributable to positive characteristics of everyday social interactions.

### Table 4. (continued)

|                         | Model 1       | Model 2       |
|-------------------------|---------------|---------------|
|                         | B (SE)        | P             | B (SE)        | p              |
| (e) In-person interactions |               |               |               |                |
| Yesterday's psychiatric symptoms | .25 (.02) <.001 | .25 (.02) <.001 |                |
| Day of assessment | -.00 (.00) .91 | -.00 (.00) .88 |                |
| Pandemic-related stressors | .59 (.05) <.001 | .59 (.05) <.001 |                |
| In-person interactions (between-person averages) | .02 (.09) .79 | .02 (.09) .79 |                |
| In-person interactions (within-person fluctuations) | -.02 (.02) .34 | -.17 (.09) .06 |                |
| In-person interactions (within-person fluctuations) × stressors |                |                | .08 (.05) .09 |
| Log restricted-likelihood | -6139.54 |                | -6140.17 |                |
| (f) Interaction frequency |               |               |               |                |
| Yesterday's psychiatric symptoms | .25 (.02) <.001 | .25 (.02) <.001 |                |
| Day of assessment | -.00 (.00) .87 | -.00 (.00) .86 |                |
| Pandemic-related stressors | .58 (.05) <.001 | .58 (.05) <.001 |                |
| Interaction frequency (between-person averages) | .14 (.08) .06 | .14 (.08) .06 |                |
| Interaction frequency (within-person fluctuations) | -.03 (.03) .39 | .05 (.13) .72 |                |
| Interaction frequency (within-person fluctuations) × stressors |                |                | -.04 (.07) .56 |
| Log restricted-likelihood | -6137.52 |                | -6139.10 |                |

Note. Effects of social interaction characteristics were examined in separate models that included covariates for yesterday’s psychiatric symptoms, assessment day (coded continuously as number of days since study entry; range = 0–21), and pandemic-related stressors.
This study evaluated whether within-person fluctuations in everyday social interaction characteristics (i.e., daily deviations from a respondent’s average value) predicted daily changes in mental health via main effect or via stress-buffering effect (Aim 3). Analyses of daily fluctuations provide more stringent evidence that everyday social interaction characteristics are causally associated with changes in mental health by eliminating the influence of between-person confounds such as demographic and personality characteristics (Hoffman & Stawski, 2009). When interaction characteristics were examined in separate models, we found evidence for main effects and stress-buffering effects of fluctuations in pleasantness and received support. When interaction characteristics were examined in the same model, we found a main effect and a stress-buffering effect of fluctuations in pleasantness; in contrast, we did not find either a main effect or a stress-buffering effect of fluctuations in received support. One explanation for these findings is that the beneficial effect of received support on mental health is mediated by pleasantness. Subsequent research is warranted to test this possibility and to examine the specific types of received support that are associated with pleasantness in everyday social interactions.

Our results are consistent with the assertion that everyday social interactions, but not the global perceived availability of social support, may be the active ingredient in facilitating daily regulation of mental health in the face of stressors (Lakey & Orehek, 2011). Additional research is warranted to test this possibility and to examine the impact

Figure 2. Stress-buffering effects of within-person fluctuations in pleasantness and received support on daily psychiatric symptoms when tested in the same model.
of everyday social interactions on mental health across longer timescales (e.g., months, years). More investigation is also needed to disentangle the measurement of global perceived social support, received support, and pleasantness, and to examine the potential moderating effect of perceived support × received support in everyday social interactions on mental health (e.g., Holmstrom et al., 2015). Consistent with earlier research (Haber et al., 2007), we found only a weak correlation of global perceived social support and average ratings of received support in everyday social interactions. Future studies are needed to clarify the specific behavioral and psychological processes that are represented by measures of global perceived social support.

**Strengths and limitations**

Notable strengths of this investigation include the assessment of discrete everyday social interactions in a respondent’s natural environment on multiple occasions each day for 21 days, and the collection of longitudinal data assessing psychiatric symptoms in a large nationwide sample of United States adults during the COVID-19 pandemic. Another strength of this investigation is the consistent finding at two timescales of an association between interaction pleasantness and mental health.

Limitations to this study also provide opportunity for future investigation. First, our measure of pandemic-related stressors predicted daily psychiatric symptoms, but was not associated with changes in psychiatric symptoms at 3-week follow-up. One plausible reason this occurred was that our measure of pandemic-related stressors was static and captured only those stressors that had occurred prior to the study. Another plausible reason was that our measure of pandemic-related stressors may not have captured the full range of stressful life events that impacted trajectories of mental health during a pandemic. This is especially likely to be the case if the largest impact of pandemic-related stressors on mental health occurred closer to the start of the pandemic and plateaued before our data collection started. Second, we were unable to determine the extent to which perceptions of discrete social interactions were driven by the actual content of an interaction, or by an individual’s preexisting cognitions and beliefs about the individual(s) with whom they were interacting, or by other unmeasured characteristics of the interaction. Third, we acknowledge the need for subsequent investigation of the temporality of the associations between perceived social support, everyday social interactions, and mental health. We examined changes in mental health across 3 weeks of follow-up (Aims 1–2) and across days (Aim 3) in our study because we intended to capture the rapid pandemic-related changes that were occurring in the United States when these data were collected, and because we aimed to maintain consistency with other studies of mental health during the COVID-19 pandemic (Brose et al., 2021). Fourth, our study did not assess respondents’ sexual orientation or disability status. It is important for future studies to consider the role of these demographic characteristics in the association of perceived social support, everyday social interactions, and mental health.

Finally, even though our EMA measures of pleasantness and received support were derived from theory (Cohen & Wills, 1985; Lakey & Orehek, 2011; Thoits, 2011) and adapted from existing measures (Reis et al., 2017), they have not been used in previous
studies. In particular, our pleasantness measure consisted of six items that were selected because of their common factor loading. Further validation research is needed to determine whether the observed beneficial effects of interaction pleasantness on mental health were driven by specific positive qualities of everyday social interactions, such as perceived partner responsiveness (Reis et al., 2017). Limitations of our received support measure include collapsing across social support subtypes (i.e., emotional, tangible, esteem; Cutrona & Suhr, 1992) and the potential confounding of support receipt and support quality (i.e., “Someone provided you helpful information”). Subsequent experimental studies are needed to assess whether the association of pleasant social interactions and mental health is causal, and whether psychosocial interventions targeting interaction pleasantness may hold promise for improving mental health outcomes.

Conclusions

This prospective study of United States adults found that higher levels of perceived social support predicted decreases in psychiatric symptoms across 3 weeks of follow-up. Results of this study inform previous theories of how perceived social support benefits mental health by identifying pleasantness as a core characteristic of everyday social interactions that could account for the positive effect of perceived social support on mental health. Results also provide novel evidence for within-person associations of everyday social interaction characteristics and daily changes in mental health, and suggest the centrality of everyday social interactions (and not the global perceived availability of social support) in facilitating the daily regulation of mental health. These findings may help to inform the development of psychosocial interventions that promote pleasant everyday social interactions with the overall aim of improving mental health.

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Open research statement

As part of IARR’s encouragement of open research practices, the authors have provided the following information: This research was not pre-registered. The data and materials used in the research are available and can be obtained by emailing the first-author at brian.chin@trincoll.

Supplemental Material

Supplemental material for this article is available online.
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