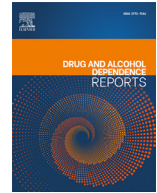




Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Were self-described introverts "immune" to increased drug use and entrapment during the pandemic?

Leigh V. Panlilio*, Anysia Lee, Kirsten E. Smith, David H. Epstein

Real-world Assessment, Prediction, and Treatment Unit, Translational Addiction Medicine Branch, Intramural Research Program, National Institute on Drug Abuse, 251 Bayview Blvd, Baltimore, MD 21224, United States

ARTICLE INFO

Keywords:

COVID-19
Social activity
Entrapment
Alcohol
Opioids
Psychostimulants

ABSTRACT

Background: Social restrictions and other stressors related to the Covid-19 pandemic disrupted daily life in ways that might have increased drug use and undermined mental health. We investigated whether such changes depended on the amount and quality of a person's social activity. We also evaluated the popular idea that effects of pandemic-related restrictions would depend on introversion; to this end, we used self-described introversion as a proxy for preferred frequency of social activity.

Methods: Between September 2020 and March 2021, we obtained online-survey data from 2615 respondents who retrospectively reported alcohol, opioid, or psychostimulant use. We analyzed (1) changes in drug use and entrapment (a psychological construct linked to suicidality) as a function of introversion and the frequency and quality of social activity, and (2) changes in drug use as a function of change in entrapment.

Results: Most felt more entrapped during the pandemic, but only a minority increased drug use. Generally: (1) entrapment and drug use increased in respondents unsatisfied with their social activity, (2) introversion and frequency of activity had less influence than satisfaction, (3) introverts reported more symptoms of entrapment, anxiety, depression, and loneliness than non-introverts, (4) when social activity was frequent and unsatisfying, psychostimulant use increased in introverts and opioid use increased in extraverts, (5) alcohol use increased in those who felt increased entrapment, and (6) alcohol and opioid use decreased in those who felt decreased entrapment.

Conclusions: Satisfactory social activity (even in small amounts) was associated with better outcomes, mostly without regard to introversion.

1. Introduction

Physical-distancing measures and other restrictions associated with the Covid-19 pandemic have disrupted everyday life, cutting across social strata to affect virtually everyone. The extent and direction of these effects on any one person may depend on, among other things, social environment and personality. People vary in how much they interact with others and how much satisfaction they derive from these interactions. They also vary in their typical and preferred forms of social interaction (e.g., in-person versus online, and verbal versus shared activities), which can have different effects on mental health (Cole et al., 2017; Longman et al., 2009; Sparling et al., 2017; Tibbetts et al., 2021a, 2021b).

We hypothesized that the psychological effects of pandemic-related restrictions are influenced by whether the social activities in which people can engage (or are obligated to engage) match the amount and quality they desire. For example, faced with reduced amounts of in-person

talking, some would feel deprived of intimacy and expression, but others would feel relieved from social pressure. That scenario is central to a media narrative that emerged over the first year of the pandemic, that introverts have been thriving under lockdown conditions where non-introverts feel entrapped (Barth, 2021; Kluth, 2020; Robson, 2021). This narrative centers on a lay understanding of introversion—an understanding related to but not identical with introversion in formal personality theory (Dahl, 2020). As presented in popular books, articles, and memes, introversion is generally described as being drained or fatigued by frequent or prolonged interaction with people, and being recharged or restored by time alone.

A second narrative, supported by several studies, is that many people have increased their use of alcohol and other drugs, possibly due to psychological effect of pandemic-related social restrictions (Barbosa et al., 2021; Horigian et al., 2021; Rodriguez et al., 2020; Schmidt et al., 2021). With respect to these processes, we hypothesized that people's behavioral responses to pandemic-related restrictions could be driven in either a favorable or unfavorable direction depending on the degree of match

* Corresponding author.

E-mail address: lpanlili@intra.nida.nih.gov (L.V. Panlilio).

(or mismatch) between their self-rated degree of introversion and the social demands (or opportunities) associated with the microenvironment into which they were locked down. We examined that hypothesis in crowdsourced survey data we collected as part of a broader study of drug use. We asked our respondents—all of whom reported having used alcohol, opioids, or psychostimulants in the previous six months—about introversion, changes in drug use during the pandemic, and changes in their sense of *entrapment*. Entrapment is a feeling of being unable to escape internal and/or external stressors and has been linked to depression and suicidal behavior (Carvalho et al., 2021; Gilbert and Allan, 1998; Höller et al., 2021; Stenzel et al., 2020). Increased entrapment seems likely to result from a mismatch between social preferences and social circumstances—and might plausibly cause more drug use. We posited this “match vs. mismatch” scenario as a refinement of the ideas that introverts were uniformly thriving or that drug use was uniformly increasing. Our aims were to determine whether (1) changes in entrapment and drug use were related to the amount and quality of social interaction, and (2) the nature of this relationship was influenced by self-described introversion. To assess the general qualities associated with self-described introversion, we also calculated its correlations with psychometric assessments of loneliness, anxiety, and depression, adverse emotional states that have been associated with the pandemic (Benke et al., 2020; Horigian et al., 2021; Murata et al., 2021).

2. Methods

The methods are described briefly here. For more details, see “Supplement–Methods.”

2.1. Recruiting

Respondents were enrolled using the online crowdsourcing platform, Amazon Mechanical Turk (mTurk). Eligibility requirements were: residence in the United States (US), proficiency in English, age ≥ 18 years, previous completion of ≥ 100 mTurk tasks, and self-reported use of one of the following classes of drugs during the six month period prior to screening: (1) alcohol; (2) prescribed or nonprescribed opioids; or (3) nonprescribed psychostimulants. This was intended to be a nonclinical sample; we did not require problematic use for eligibility.

2.2. Respondents

Between September 3, 2020 and March 31, 2021, a total of 13,608 respondents completed an 8-item screening survey; 5112 were deemed eligible, and 2615 (51% of those eligible) completed the full survey (hosted on Qualtrics) and passed quality checks. Eighty percent used only alcohol. Most who used opioids or stimulants also used alcohol (75% and 77%, respectively), and 16% of those who used either opioids or stimulants used both (see Venn diagram in “Supplement–Regression variables”). For more information, see “Supplement–Demographics.”

2.3. Brief psychometric instruments

Past-month loneliness was assessed using the 20-item University of California, Los Angeles (UCLA) Loneliness Scale (Doryab et al., 2019; Russell, 1996). *Past-month depression* was assessed using the Center for Epidemiologic Studies Short Depression Scale (CES-D-R-10) Björqvinnson et al., 2013; Miller et al., 2008; Radloff, 1977. *Past-month anxiety* was assessed using the Generalized Anxiety Disorder Scale (GAD-7; (Spitzer et al., 2006). *Entrapment* was assessed using two unidimensional scales (Gilbert and Allan, 1998): Internal Entrapment, based on 6 items (e.g., “I want to get away from myself,” “I feel trapped inside myself”) related to escape motivation stemming from internal stimuli (i.e., cognitions, emotions); and External Entrapment, based on 10 items related to escape motivation stemming from external conditions (e.g., “I feel trapped by other people,” “I feel powerless to change things”).

2.4. Assessment of social activity and changes in drug use and entrapment

For each drug used in the past 12 months, we asked, “Has your use of ___ increased or decreased since the Covid-19 pandemic began?” These responses were used to determine categorical (ordinal) outcomes for change in use of opioids, stimulants, and alcohol (“Increased,” “Decreased,” or “Not changed” within each drug class). Our question about *change* in entrapment immediately followed the set of questions (described above) that assessed *levels* of entrapment. Specifically, we asked, “Related to these feelings of being trapped, how have these feelings changed since the Covid-19 pandemic began?” This question could be answered, “Much worse,” “A little worse,” “No change,” “A little better,” or “Much better.” Four types of social activity were assessed by asking how many of the past 30 days included at least 30 min of the activity, and “how satisfying” the activity was. The activity types were in-person talking, in-person shared activities, online talking, and online shared activities. Satisfaction from each type of socializing was assessed on a visual analog scale (VAS) of 0–100, with a higher number indicating greater satisfaction. Self-described introversion was assessed with a VAS (0–100) in response to the question, “I would consider myself an introvert.”

3. Data analysis

Statistical models were used to assess changes in entrapment or drug use as a function of self-described introversion and social activity, with separate models for entrapment and each of the three drug classes. Because some respondents did not engage in some activities, we did not use each activity as a separate regressor. Instead, as detailed in “Supplement–Methods,” we used hierarchical clustering to identify 8 natural groups of respondents who shared similar patterns of activity type and satisfaction, then used cluster membership as a categorical regressor. In three additional models (one for each drug class), we assessed change in drug use as a function of change in entrapment, along with introversion and demographic covariates (age, sex/gender, race/ethnicity, and Hispanicity). Numeric variables were standardized to facilitate interpretation and comparison of coefficients (see “Supplement–Regression variables” for raw means and standard deviations).

Each outcome was treated as an ordinal variable in a Bayesian regression (Bürkner, 2017; Bürkner and Vuore, 2019). Posterior distributions from these regressions provided (1) credible intervals for the coefficients, (2) Bayesian p values representing one minus the probability that the coefficient is nonzero (Makowski et al., 2019), and (3) model-fitted probabilities for each ordinal category of the outcome. All effects are best understood by inspecting plots showing the probability of each ordinal level of the outcome as a function of the regressors; these plots also illustrate effect size (i.e., how much the outcomes are affected by the regressors). Credibly nonzero effects (Bayesian $p < .1$) are highlighted in the coefficient tables and forest plots (provided in “Supplement–Coefficients”) to facilitate interpretation.

4. Results

4.1. Distributions of the introversion and social-activity variables

Most respondents rated themselves above 50 on the 0–100 scale of introversion, but many rated themselves below 50 (histograms in “Supplement–Regression variables”). For online shared activities (lower row of histograms), the number of days that included the activity peaked at 0 (46% of respondents); for all other activities, there were some respondents with 0 days (4–10%), but the distributions peaked at the maximum of 30 days (middle row). Satisfaction ratings were mostly high, with each mode at the maximum (lower row).

4.2. Psychological and social-activity characteristics associated with self-described introversion

Introversion had: (1) a moderate positive correlation with entrapment rating, (2) a small positive correlation with change in entrapment during the pandemic, (3) a moderate negative correlation with satisfaction from each activity except online shared activity, (4) a small negative correlation with days of social activities, and (5) positive correlations with scales of negative affective states (loneliness, depression, and anxiety) (See correlation matrix in "Supplement–Regression variables"). Negative affective variables were positively correlated with each other, with entrapment levels, and to a lesser extent with change in entrapment during the pandemic. Negative affective variables were *negatively* correlated with satisfaction from each of the four kinds of social activity (i.e., negative affect tended to be higher when satisfaction was low); negative affect, especially loneliness, was also negatively correlated with days of activity, except for online shared activity. Mean \pm standard deviation scores were 11.1 ± 6.9 for depression (with ≥ 10 considered "depressed"), 7.4 ± 5.7 for anxiety (with 5–9 considered "mild") and 25.8 ± 13.1 for loneliness (with ≥ 25 considered "high"). There were moderate to strong positive correlations among satisfaction ratings for all four types of social activity, and a strong correlation between days with in-person talking and days with in-person shared activities. Correlations were small and positive between the "days" variable and the "satisfaction" variable within each type of activity, and slightly stronger within the online types. Satisfaction from in-person talking and in-person shared activities had moderate negative correlations with levels of entrapment, but weaker negative correlations with *change* in entrapment during the pandemic. Each of the multi-item scales had high internal consistency, with Cronbach's $\alpha = 0.94$ for internal entrapment, 0.94 for external entrapment, 0.95 for loneliness, 0.91 for depression and 0.93 for anxiety.

4.3. Overview of changes in entrapment and drug use

Most respondents reported that feelings of entrapment were either unchanged or became "a little worse" during the pandemic (Fig. 1, second row); there were also many who reported "much worse" entrapment, but relatively few who reported improvement. These changes were consistent across drug classes, but worsening was somewhat more likely (and "no change" was less likely) for stimulant use. Many reported no change in drug use since the pandemic began, but a substantial proportion reported increases or decreases (Fig. 1, upper row). Increased use was more likely than decreased use for stimulants, but about as likely as decreased use for alcohol and opioids.

The proportion of respondents who reported increased drug use was generally highest among those who reported that their entrapment was worsened (Fig. 1, last two columns of lower panel). The proportion reporting *decreased* use was highest among those who reported *improved* entrapment (first two columns), especially in the minority whose entrapment became "much better" during the pandemic.

4.4. Model of change in entrapment and drug use as a function of introversion and social-activity cluster

The eight social-activity clusters are described in detail in "Supplement–Methods." In brief, Clusters 1 through 5 engaged in various forms of social activity, and they received moderate to high levels of satisfaction from the activities they engaged in most frequently (Fig. 2). Clusters 6 and 7 also engaged in various forms of social activity, but they found these activities unsatisfying. Cluster 8 rarely engaged in any of the social activities, and when they did they found it unsatisfying.

Satisfaction had a substantial association with change in entrapment: the unsatisfied clusters (Clusters 6–8) were about twice as likely as the others to feel increased entrapment, and they were also substantially more likely than all others except Cluster 3 to have increased alcohol

use (Fig. 3; see also "Supplement–Effects"). For Cluster 5, which had infrequent but satisfying in-person social activities, decreased alcohol use was slightly more likely in respondents low in introversion (i.e., extraverts). In the models of change in opioid and stimulant use, most of the nonzero effects involved interactions between cluster and introversion. Specifically, respondents in Cluster 2 were more likely to increase their opioid use if they were introverted, and respondents in Clusters 4 and 6 were more likely to increase their stimulant use if they were introverted. Conversely, respondents in Cluster 6 were less likely to increase their *opioid* use if they were introverted. Respondents in Cluster 8 were less likely to increase their stimulant use if they were introverted.

The precision of estimation was noticeably lower for certain demographic variables in the opioid and stimulant models. With that caveat, the demographic results suggest that female respondents were more likely to have increased alcohol use, gender-nonbinary respondents were more likely than male or female respondents to have increased entrapment or opioid use, Hispanic respondents were more likely to have increased opioid use, Asian respondents were more likely to have increased stimulant use, and older respondents were slightly less likely than younger respondents to feel increased entrapment.

4.5. Models of change in drug use as a function of change in entrapment

Respondents who experienced improved entrapment during the pandemic were more likely to have decreased rather than increased use of alcohol or opioids (Fig. 4). Respondents with worsened entrapment were more likely to have increased rather than decreased drinking. For stimulants, the point estimates followed a pattern somewhat similar to those for alcohol and opioids (i.e., with decreased use less likely and increased use more likely going from left to right in Fig. 4), but the credible intervals were wider and overlapping, suggesting that the lack of a credible difference within the stimulant results might be due to the lower number of respondents (especially in the "much better" entrapment category) and to a general tendency for stimulant use to increase, rather than to a lack of relationship between stimulant use and entrapment (for further exploration, see "Dot plots" in "Supplement–Effects").

5. Discussion

About half of our respondents reported no change in drug use during the pandemic, and the number who reported decreased use was almost as high as the number who reported increased use. Most felt worsened entrapment, but almost as many reported no change. A fortunate few felt less entrapped, and they tended to be the ones who had decreased alcohol or opioid use. Those who were unsatisfied with social activities were likely to experience increased entrapment or alcohol use. The probability of experiencing increased entrapment or increased alcohol use was about 40% higher in clusters of respondents who were unsatisfied with their social activities compared to those who were satisfied.

Generally, changes in entrapment and drug use were related more to satisfaction from social activity than to the amount of activity. For example, Cluster 5 (which had one of the lowest probabilities of increased entrapment) consisted of respondents who were satisfied by their in-person social activities, even though the frequency of these activities was below average, and Cluster 6 (which had one of the *highest* probabilities of increased entrapment) had the opposite profile of social activity: above-average frequency and below-average satisfaction. This finding is consistent with studies showing that well-being is positively associated with in-person and online social activity among people who have close social ties (Tibbetts et al., 2021a, 2021b), and that people with moderate levels of social activity tend to have higher levels of well-being (Sun et al., 2020), but high levels of activity are not more beneficial than moderate levels (Ren et al., 2021). These results for Cluster 6 (high-frequency, low

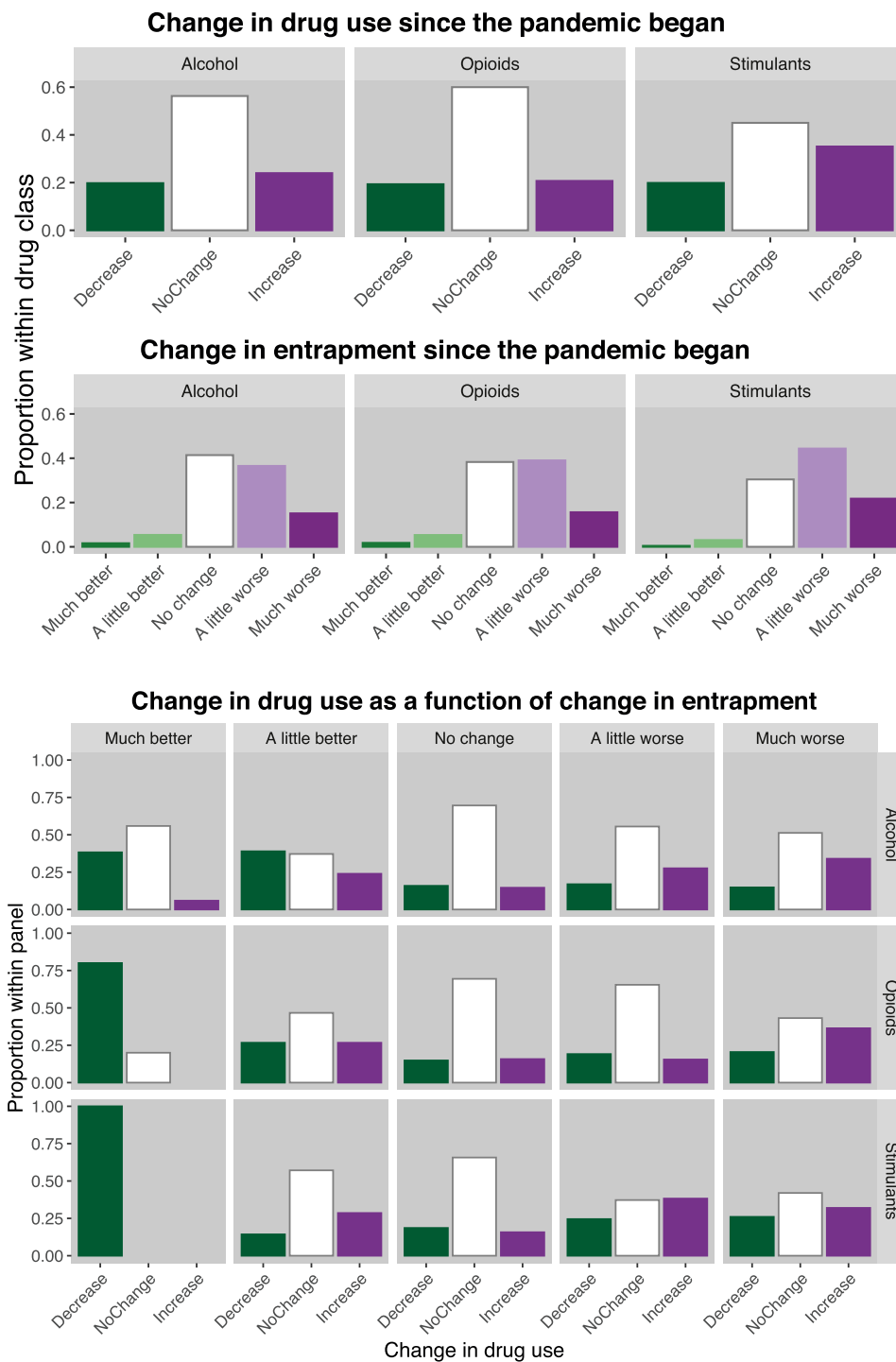


Fig. 1. Observed proportions of respondents who endorsed each ordinal category of change in drug use ("Change in drug use since the pandemic began") or change in entrapment ("Change in entrapment since the pandemic began"), or each combination of change in drug use with change in entrapment ("Change in drug use as a function of change in entrapment").

satisfaction) support our expectation that high exposure to unsatisfying social activity would be detrimental. There was only equivocal support for the idea that higher amounts of social activity would be specifically detrimental in introverts; that is, introverts in Cluster 6 were more likely than extraverts to have increased stimulant use, but they were also more likely to have decreased opioid use.

The apparently protective effects of satisfying social activity did not depend strongly on self-described introversion with respect to entrapment or alcohol use, but they did for opioid and stimulant use. It is unclear why introverts in Cluster 6 would have increased stimu-

lant use but extraverts in Cluster 6 would have increased opioid use. Perhaps the best-known distinction between opioids and stimulants as "drugs of choice" is the self-medication hypothesis, which, in its original formulation, held that opioids are used to self-medicate anger while stimulants are used to self-medicate depression or social anxiety (Khantzian, 1985)—but that assertion has not fared well empirically (Craig and Olson, 1990; O'Connor and Berry, 1990; Suh et al., 2008). A more current and better-supported distinction between the two drug classes is situational: opioid use tends to occur at home, while stimulant use tends to occur outside the home (Ahmed et al., 2020; Badiani, 2013).

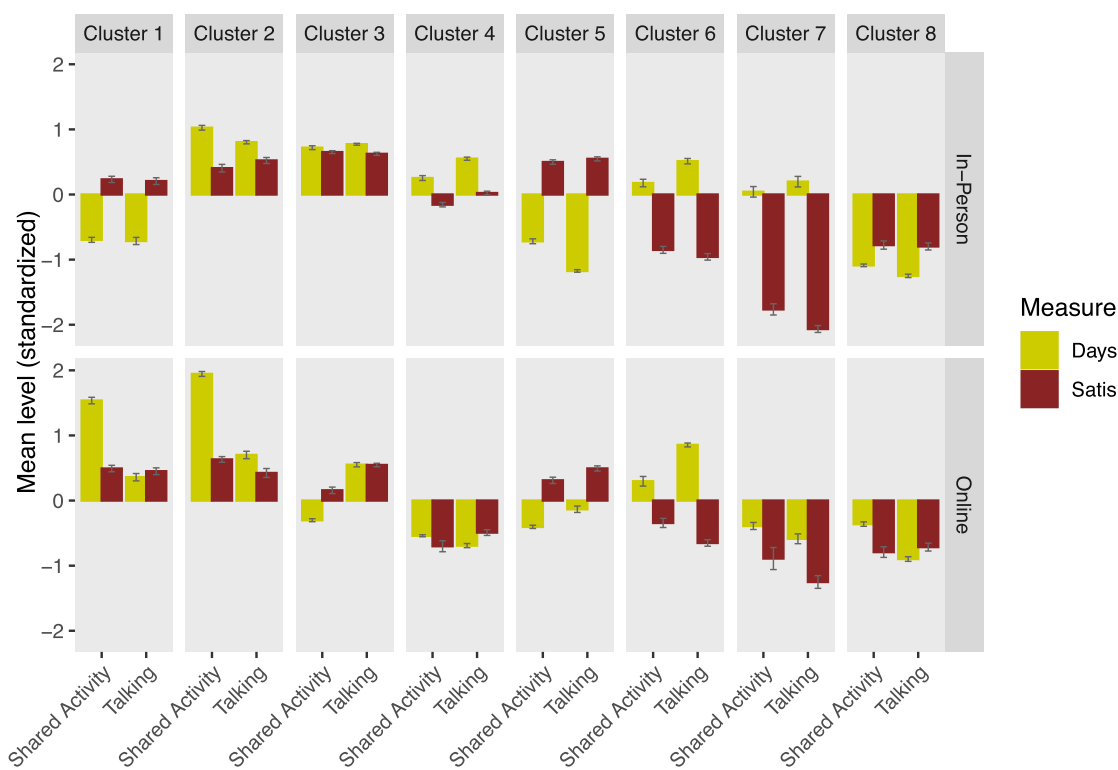


Fig. 2. Mean (\pm standard error of the mean) levels of social activity—and satisfaction from the activity—for each of the eight clusters. "Days" represent the standardized number of days out of the past 30 that included at least 30 min of the activity. "Satis" represents the standardized level of satisfaction obtained from the activity. For each variable, a value of zero represents the average level across all respondents, and increments above or below zero are in units of standard deviations for the variable. For each cluster, days and satisfaction values are presented for in-person shared activities and in-person talking (upper row), and for online shared activities and online talking (lower row).

Self-described introverts and extraverts could have differed with respect to how much time they spent at home, or how their amount of time at home was changed by the pandemic, and it seems likely that extraverts would be less satisfied if they had to spend more time than usual at home.

Self-described introversion is interesting because it offers insight into people's self-perception and self-awareness concerning behavioral tendencies. We found that self-described introversion was associated with measures of entrapment, loneliness, depression, anxiety, and low satisfaction from in-person talking and in-person shared activities. To a lesser extent, self-described introversion was associated with relatively infrequent in-person talking and in-person shared activities, and with increases in entrapment during the pandemic. Together, these associations suggest that self-described introversion has convergent validity, given that formal measures have shown that introversion is correlated with, loneliness, depression and anxiety (Buecker et al., 2020; Grav et al., 2012; Nikčević et al., 2021; Wei, 2020).

We did not provide a definition of introversion within our questionnaire. Instead, we relied on respondents' pre-existing understanding of the term. This was, in some respects, a truer measure of the construct of interest than would have been gained from most Big Five inventories, where scores for Extraversion/Introversion reflect items that assess not only gregariousness, but also positive affect (Costa and McCrae, 2000). Our single-item measure, like others that have been used in surveys (Gosling et al., 2003; Tibbetts et al., 2021a, 2021b), assessed introversion as an identity. A major goal of this study was to assess whether self-identified introverts fared better during the pandemic, a question that has received considerable media coverage (Barth, 2021; Kluth, 2020; Robson, 2021), some of which mentioned that this idea was not supported by an early study conducted by Gubler et al. (2020).

Assuming that the self-described introversion in our respondents was a trait they had prior to the pandemic and was not a result of the pandemic, our results are consistent with the idea that self-described introversion moderated the relationships between social activity and changes in opioid and stimulant use, with opposite effects for opioids vs. stimulants in people who had frequent unsatisfying social activity. This finding provides some support for our "mismatch" hypothesis (whereby introverts and extraverts would have different reactions if their levels of socializing were minimal), but it does not support the media narrative that introverts were less affected. Overall, the main finding is that even self-identified introverts need some minimal level of satisfying social interaction, often to a greater extent than they expect (Epley and Schroeder, 2014; Ren et al., 2021).

5.1. Limitations and future directions

Some of these findings could be specific to populations similar to the one we studied, a convenience sample of US adults with active mTurk accounts, most of whom rated themselves as being 50 or higher on our 0–100 scale of introversion. The data were cross-sectional and based on self-report of feelings and behavior after the fact, with the potential for recall bias. Questions were phrased as relating to changes "since the pandemic began," but results might have differed if the data had been collected prospectively or longitudinally. We used increases or decreases in use of alcohol and other drugs use as proxies for "change for the better" and "change for the worse" (respectively). In sensitivity analyses (not shown), we found that our conclusions were similar if we used survey items in which we directly asked respondents about changes for the better or worse (rather than increases or decreases) in their drinking and drug use.

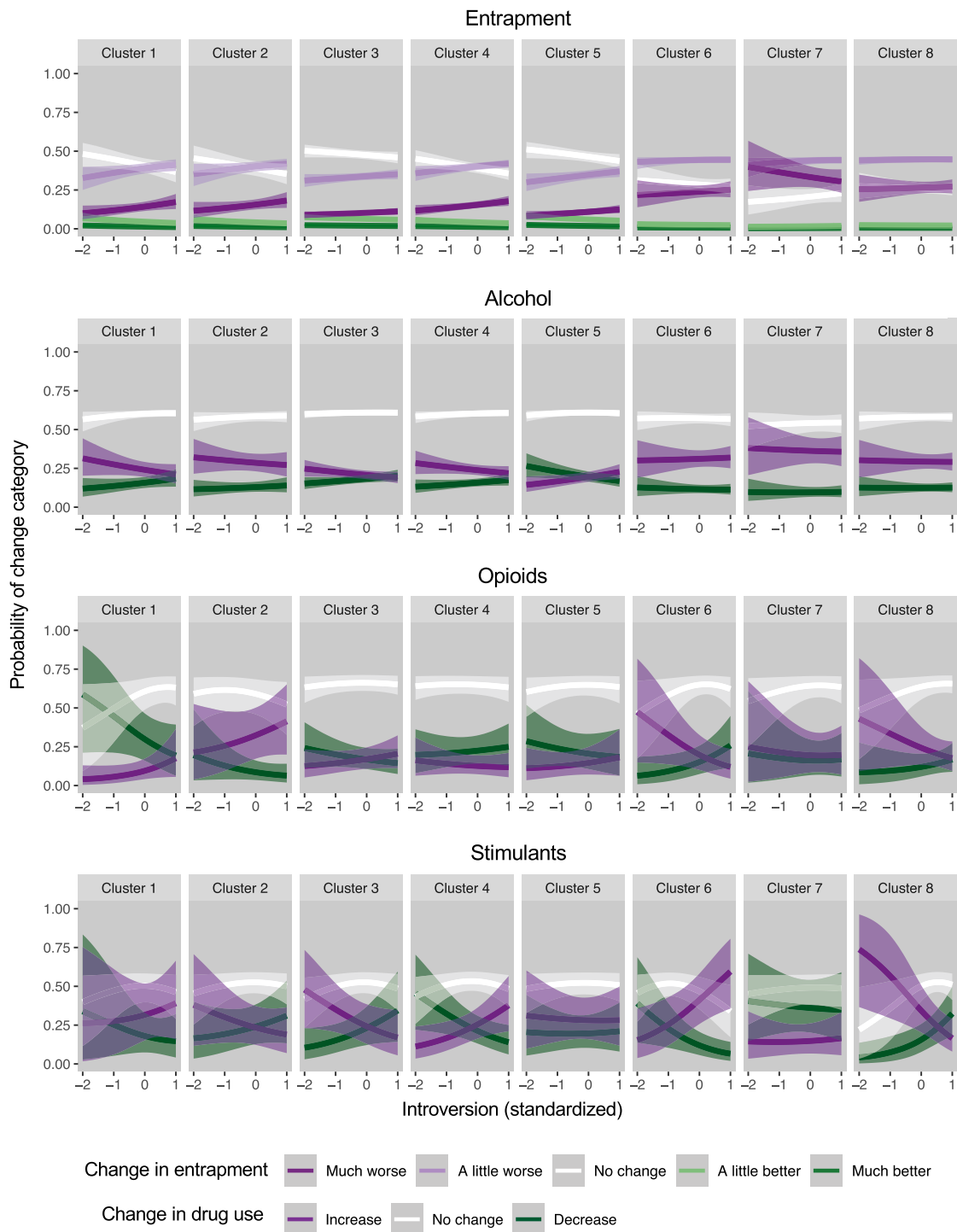


Fig. 3. Model-fitted estimates of the probability of each ordinal outcome from models of change in entrapment or change in drug use as a function of self-described introversion and social activity cluster. The ordinal outcomes are indicated by color, with green representing a decrease and purple representing an increase. Units on the horizontal axis (self-described introversion) represent standard deviations above or below zero, with zero representing the overall mean for all respondents. Lines represent medians. Error bands represent 90% credible intervals.

Despite its limitations, this study represents a large, deep, and direct examination of changes in drug use during the pandemic, and it offers clues to the relationship between social activity, mental health, and drug use in general. Even as the pandemic evolves and new norms of social activity emerge after periods of restriction, there will always be

people with suboptimal levels of satisfying social interactions. These relationships between social activity, drug use, and mental health deserve further attention, to study the causal direction of the effects and to assess the utility of focusing on satisfying social activity as a predictive measure and as an intervention for decreasing drug use.

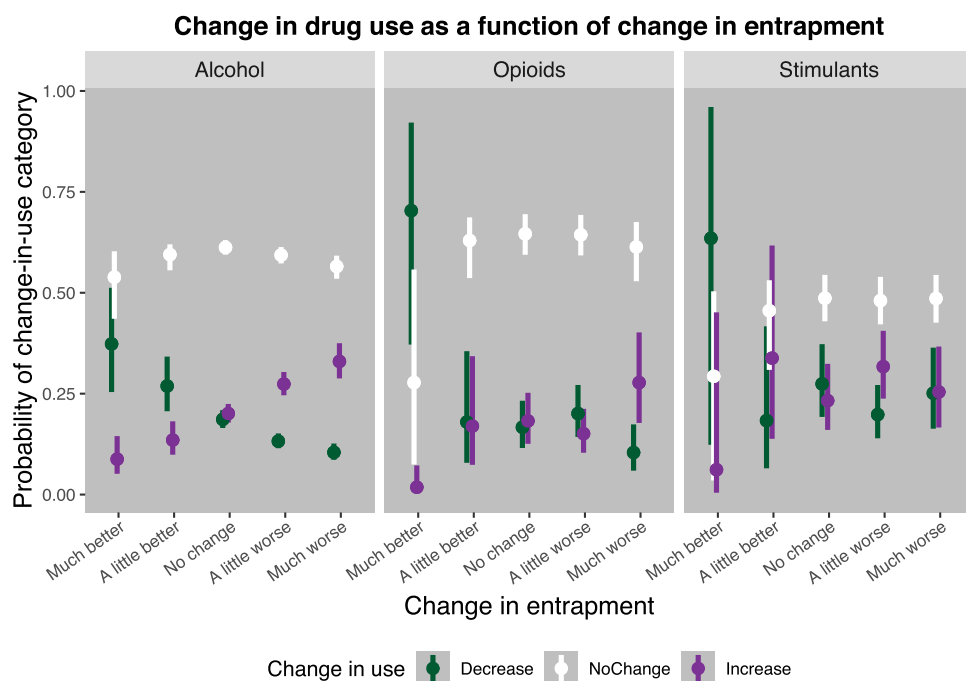


Fig. 4. Model-fitted estimates of the probability of each ordinal outcome from models of change in drug use as a function of change in entrapment, with a separate model for each drug class. Points represent medians. Error bars represent 90% credible intervals.

Role of funding source

Nothing declared.

Supporting information

Supplementary material

Declaration of Competing Interest

No conflict declared.

CRedit authorship contribution statement

Leigh V. Panlilio: Visualization, Formal analysis, Writing – original draft, Writing – review & editing. **Anysia Lee:** Conceptualization, Writing – original draft, Writing – review & editing. **Kirsten E. Smith:** Conceptualization, Data curation, Writing – original draft, Writing – review & editing. **David H. Epstein:** Conceptualization, Data curation, Writing – original draft, Writing – review & editing.

Acknowledgments

This research was supported by the Intramural Research Program of the NIH, National Institute on Drug Abuse.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.dadr.2022.100024](https://doi.org/10.1016/j.dadr.2022.100024).

References

- Ahmed, S.H., Badiani, A., Miczek, K.A., Müller, C.P., 2020. Non-pharmacological factors that determine drug use and addiction. *Neurosci. Biobehav. Rev.* 110, 3–27. doi:[10.1016/j.neubiorev.2018.08.015](https://doi.org/10.1016/j.neubiorev.2018.08.015).
- Badiani, A., 2013. Substance-specific environmental influences on drug use and drug preference in animals and humans. *Curr. Opin. Neurobiol.* 23 (4), 588–596. doi:[10.1016/j.conb.2013.03.010](https://doi.org/10.1016/j.conb.2013.03.010).

- Barbosa, C., Cowell, A.J., Dowd, W.N., 2021. Alcohol consumption in response to the COVID-19 Pandemic in the United States. *J. Addict. Med.* 15 (4), 341–344. doi:[10.1097/adm.0000000000000767](https://doi.org/10.1097/adm.0000000000000767).
- Barth, F.D. (2021). Pandemic lessons from introverts can help everyone. Retrieved October 25, 2021 from <https://www.psychologytoday.com/us/blog/the-couch/202105/pandemic-lessons-introverts-can-help-everyone>
- Benke, C., Autenrieth, L.K., Asselmann, E., Pané-Farré, C.A., 2020. Lockdown, quarantine measures, and social distancing: associations with depression, anxiety and distress at the beginning of the COVID-19 pandemic among adults from Germany. *Psychiatry Res.* 293, 113462. doi:[10.1016/j.psychres.2020.113462](https://doi.org/10.1016/j.psychres.2020.113462).
- Björgvinsson, T., Kertz, S.J., Bigda-Peyton, J.S., McCoy, K.L., Aderka, I.M., et al., 2013. Psychometric properties of the CES-D-10 in a psychiatric sample. *Assessment* 20, 429–436.
- Buecker, S., Maes, M., Denissen, J.J.A., Luhmann, M., 2020. Loneliness and the big five personality traits: a meta-analysis. *Eur. J. Personal.* 34 (1), 8–28. doi:[10.1002/per.2229](https://doi.org/10.1002/per.2229).
- Bürkner, P.C., 2017. brms: an R package for Bayesian multilevel models using stan. *J. Stat. Softw.* 80 (1), 1–28. doi:[10.18637/jss.v080.i01](https://doi.org/10.18637/jss.v080.i01).
- Bürkner, P.C., Vuorre, M., 2019. Ordinal regression models in psychology: a tutorial. *Adv. Methods Pract. Psychol. Sci.* 2 (1), 77–101. doi:[10.1177/2515245918823199](https://doi.org/10.1177/2515245918823199).
- Carvalho, S., Caetano, F., Pinto-Gouveia, J., Mota-Pereira, J., Maia, D., Pimentel, P., Priscila, C., Gilbert, P., 2021. Predictors of poor 6-week outcome in a cohort of major depressive disorder patients treated with antidepressant medication: the role of entrapment. *Nord. J. Psychiatry* 75 (1), 38–48. doi:[10.1080/08039488.2020.1790657](https://doi.org/10.1080/08039488.2020.1790657).
- Cole, D.A., Nick, E.A., Zerkowicz, R.L., Roeder, K.M., Spinelli, T., 2017. Online social support for young people: does it recapitulate in-person social support; Can it help? *Comput. Hum. Behav.* 68, 456–464. doi:[10.1016/j.chb.2016.11.058](https://doi.org/10.1016/j.chb.2016.11.058).
- Costa, P.T., McCrae, R.M., 2000. *NEO Personality Inventory*. Oxford University Press.
- Craig, R.J., Olson, R.E., 1990. MCMI comparisons of cocaine abusers and heroin addicts. *J. Clin. Psychol.* 46, 230–237. doi:[10.1002/1097-4679\(199003\)46:2:3C230::AID-JCLP2270460217.E3.0.CO;2-7](https://doi.org/10.1002/1097-4679(199003)46:2:3C230::AID-JCLP2270460217.E3.0.CO;2-7).
- Dahl, M. (2020). Apparently there are 4 kinds of introversion. Retrieved October 25, 2021 from <https://www.thecut.com/article/apparently-there-are-four-kinds-of-introversion.html>
- Doryab, A., Villalba, D.K., Chikersal, P., Dutcher, J.M., Tumminia, M., Liu, X., Cohen, S., Creswell, K., Mankoff, J., Creswell, J.D., Dey, A.K., 2019. Identifying behavioral phenotypes of loneliness and social isolation with passive sensing: statistical analysis, data mining and machine learning of smartphone and Fitbit data. *JMIR Mhealth Uhealth* 7 (7), e13209. doi:[10.2196/13209](https://doi.org/10.2196/13209).
- Epley, N., Schroeder, J., 2014. Mistakenly seeking solitude. *J. Exp. Psychol. Gen.* 143 (5), 1980–1999. doi:[10.1037/a0037323](https://doi.org/10.1037/a0037323).
- Gilbert, P., Allan, S., 1998. The role of defeat and entrapment (arrested flight) in depression: an exploration of an evolutionary view. *Psychol. Med.* 28 (3), 585–598. doi:[10.1017/s0033291798006710](https://doi.org/10.1017/s0033291798006710).
- Gosling, S.D., Rentfrow, P.J., Swann, W.B., 2003. A very brief measure of the big-five personality domains. *J. Res. Personal.* 37 (6), 504–528. doi:[10.1016/s0092-6566\(03\)00046-1](https://doi.org/10.1016/s0092-6566(03)00046-1).

- Grav, S., Stordal, E., Romild, U.K., Hellzen, O., 2012. The relationship among neuroticism, extraversion, and depression in the HUNT Study: in relation to age and gender. *Issues Ment. Health Nurs.* 33 (11), 777–785. doi:10.3109/01612840.2012.713082.
- Gubler, D.A., Makowski, L.M., Troche, S.J., Schlegel, K., 2020. Loneliness and well-being during the Covid-19 pandemic: associations with personality and emotion regulation. *J. Happiness Stud.* 1–20. doi:10.1007/s10902-020-00326-5.
- Höller, I., Rath, D., Teismann, T., Glaesmer, H., Lucht, L., Paashaus, L., Schönfelder, A., Juckel, G., Forkmann, T., 2021. Defeat, entrapment, and suicidal ideation: twelve-month trajectories. *Suicide Life Threat. Behav.* doi:10.1111/sltb.12777.
- Horigian, V.E., Schmidt, R.D., Feaster, D.J., 2021. Loneliness, mental health, and substance use among US young adults during COVID-19. *J. Psychoact. Drugs* 53 (1), 1–9. doi:10.1080/02791072.2020.1836435.
- Khantzian, E.J., 1985. The self-medication hypothesis of addictive disorders: focus on heroin and cocaine dependence. *Am. J. Psychiatry* 142, 1259–1264. doi:10.1176/ajp.142.11.1259.
- Kluth, A. (2020). For introverts, quarantine can be a liberation. Retrieved October 25, 2021 from <https://www.bloomberg.com/opinion/articles/2020-03-28/coronavirus-for-introverts-quarantine-can-be-a-liberation>
- Longman, H., O'Connor, E., Obst, P., 2009. The effect of social support derived from World of Warcraft on negative psychological symptoms. *Cyberpsychol. Behav.* 12 (5), 563–566. doi:10.1089/cpb.2009.0001.
- Makowski, D., Ben-Shachar, M., Lüdtke, D., 2019. bayestestR: describing effects and their uncertainty, existence and significance within the Bayesian framework. *J. Open Source Softw.* (4) 4. doi:10.21105/joss.01541.
- Miller, W.C., Anton, H.A., Townson, A.F., et al., 2008. Measurement properties of the CESD scale among individuals with spinal cord injury. *Spinal Cord* 46, 287–292.
- Murata, S., Rezeppa, T., Thoma, B., Marengo, L., Krancevich, K., Chiyka, E., Hayes, B., Goodfriend, E., Deal, M., Zhong, Y., Brummit, B., Coury, T., Riston, S., Brent, D.A., Melhem, N.M., 2021. The psychiatric sequelae of the COVID-19 pandemic in adolescents, adults, and health care workers. *Depress. Anxiety* 38 (2), 233–246. doi:10.1002/da.23120.
- Nikčević, A.V., Marino, C., Kolubinski, D.C., Leach, D., Spada, M.M., 2021. Modelling the contribution of the Big Five personality traits, health anxiety, and COVID-19 psychological distress to generalised anxiety and depressive symptoms during the COVID-19 pandemic. *J. Affect. Disord.* 279, 578–584. doi:10.1016/j.jad.2020.10.053.
- O'Connor, L., Berry, J.W., 1990. The drug-of-choice phenomenon: why addicts start using their preferred drug. *J. Psychoact. Drugs* 22, 305–311. doi:10.1080/02791072.1990.10472553.
- Radloff, L.S., 1977. CES-D scale: A self report depression scale for research in the general populations. *Applied Psychological Measurement* 1, 385–401.
- Ren, D., Stavrova, O., Loh, W.W., 2021. Nonlinear effect of social interaction quantity on psychological well-being: diminishing returns or inverted U? *J. Personal. Soc. Psychol.* doi:10.1037/pspi0000373.
- Robson, D. (2021). Why introverts didn't actually 'win' lockdown. Retrieved October 25, 2021 from <https://www.bbc.com/worklife/article/20210705-why-introverts-didnt-actually-win-lockdown>
- Rodriguez, L.M., Litt, D.M., Stewart, S.H., 2020. Drinking to cope with the pandemic: the unique associations of COVID-19-related perceived threat and psychological distress to drinking behaviors in American men and women. *Addict. Behav.* 110, 106532. doi:10.1016/j.addbeh.2020.106532.
- Russell, D.W., 1996. UCLA Loneliness Scale (Version 3): reliability, validity, and factor structure. *J. Personal. Assess.* 66 (1), 20–40.
- Schmidt, R.A., Genois, R., Jin, J., Vigo, D., Rehm, J., Rush, B., 2021. The early impact of COVID-19 on the incidence, prevalence, and severity of alcohol use and other drugs: a systematic review. *Drug Alcohol Depend.* 228. doi:10.1016/j.drugalcdep.2021.109065, 109065-109065.
- Sparling, A., Stutts, L.A., Sanner, H., Eijkholt, M.M., 2017. In-person and online social participation and emotional health in individuals with multiple sclerosis. *Qual. Life Res.* 26 (11), 3089–3097. doi:10.1007/s11136-017-1645-y.
- Spitzer, R.L., Kroenke, K., Williams, J.B., Löwe, B., 2006. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch. Intern. Med.* 166 (10), 1092–1097.
- Stenzel, J.S., Höller, I., Rath, D., Hallensleben, N., Spangenberg, L., Glaesmer, H., Forkmann, T., 2020. Do feelings of defeat and entrapment change over time? An investigation of the integrated motivational-volitional model of suicidal behaviour using ecological momentary assessments. *Int. J. Environ. Res. Public Health* 17 (13). doi:10.3390/ijerph17134685.
- Suh, J.J., Robins, C.E., Ruffins, S., Albanese, M.J., Khantzian, E.J., 2008. Self-medication hypothesis: connecting affective experience and drug choice. *Psychoanal. Psychol.* 25, 518–532. doi:10.1037/0736-9735.25.3.518.
- Sun, R., Rieble, C., Liu, Y., & Sauter, D. (2020). Connected despite lockdown: the role of social interactions and social media use in wellbeing. *PsyArXiv*. doi:10.31234/osf.io/x5k8u
- Tibbetts, M., Epstein-Shuman, A., Leitao, M., Kushlev, K., 2021a. A week during COVID-19: online social interactions are associated with greater connection and more stress. *Comput. Hum. Behav. Rep.* 4, 100133. doi:10.1016/j.chbr.2021.100133.
- Tibbetts, M., Epstein-Shuman, A., Leitao, M., Kushlev, K., 2021b. A week during COVID-19: online social interactions are associated with greater connection and more stress. *Comput. Hum. Behav. Rep.* 4. doi:10.1016/j.chbr.2021.100133.
- Wei, M., 2020. Social distancing and lockdown - an introvert's paradise? An empirical investigation on the association between introversion and the psychological impact of COVID19-related circumstantial changes. *Front. Psychol.* 11, 561609. doi:10.3389/fpsyg.2020.561609.