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short communication

Understanding physical activity declines during COVID-19: The affective repercussions of disruption to exercise routines

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A R T I C L E   I N F O

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A B S T R A C T

Recent research has examined psychological factors that forestalled declines in physical activity (PA) during the early stages of the COVID-19 pandemic. Surprisingly, there has been limited evidence of an association between intrinsic motivation (IM) and PA. We reasoned that IM may have not predicted PA because COVID-19 restrictions limited opportunities to engage in exercise in ways that produced positive affective experiences (i.e., inherent rewards). Using data from a cross-sectional survey (*N* = 373 participants), we tested a moderated mediation model that predicted perceived changes to affective experiences during exercise would mediate the association between disruption to one's exercise routine and self-reported declines in PA, and that effects would be moderated by IM. Evidence of moderated mediation was found, suggesting that disruptions to exercise routines were associated with fewer positive affective experiences during exercise that predicted declines in PA engagement, especially for people who typically exercised for intrinsic reasons.

In March of 2020, various government-based orders and public health directives were implemented worldwide to control the spread of the COVID-19 virus. These changes inadvertently restricted the ways in which people could engage in physical activity (PA): fitness facilities, recreation centers, public parks, beaches, and trails were closed; sports leagues and activity classes were canceled; and additional social distancing restrictions and self-imposed quarantining limited activities that one could engage in outside of one's home and whom one could exercise with (Thebault et al., 2021). Coinciding with these changes, PA levels globally dropped (McCarthy et al., 2021; Pe pin et al., 2020; Tison et al., 2020), especially among people who were highly active prior to the pandemic (Fearnbach et al., 2021; McCarthy et al., 2021).

Several studies have since examined the association between well-established psychological predictors of PA and PA engagement during COVID-19 to determine factors that forestalled declines in PA. These studies consistently found that higher levels of self-efficacy (i.e., one's confidence in one's ability to successfully perform a behavior) and identified regulation (i.e., finding personal utility or importance in PA) were protective of PA engagement during this period of disruption (Petersen et al., 2021; Rhodes et al., 2020; Volz et al., 2021). However, these studies did not find an association between intrinsic motivation—doing an activity for its inherent rewards—or related constructs (e.g., affective judgments) and PA engagement (Petersen et al., 2021; Rhodes et al., 2020; Teran-Escobar et al., 2021; Volz et al., 2021). This finding was unexpected given the wealth of support for intrinsic motivation as a sustainable form of motivation for long-term engagement in PA (see Ng et al., 2012 and Teixeira et al., 2012 for meta- and systematic analyses) and warrants further examination of factors that might impact the association between intrinsic motivation and PA.

1. The present study

Measures of intrinsic motivation capture the extent to which one engages in an activity for inherent reasons (i.e., "I exercise because it is enjoyable"). Importantly, exercise is a broad construct and the ways in which people prefer to exercise may be characterized by various situational factors (e.g., location, type of workout, interaction partners, mood, and time of day; Furman et al., 2021; Pimm et al., 2016). For someone with high intrinsic motivation to exercise, consistency in situational factors (i.e., an exercise routine) that promote positive affective experiences should support sustained engagement in exercise. However, if they cannot exercise in a way that elicits these experiences their level of intrinsic motivation should be less predictive of their PA engagement. In other words, the extent to which one exercises because it is fun or pleasurable should not facilitate exercise in contexts when it will not be fun or pleasurable. This must be considered when examining
motivators of PA during COVID-19, as restrictions disrupted not only the ways in which people typically exercised, but also limited their ability to shift to a new exercise routine that they enjoyed. Most people were confined to exercising alone, at home or outside, and with few resources. Under these circumstances, intrinsic motivation may have not been associated with PA engagement because many people did not have opportunities to engage in exercise in a way that they enjoyed or preferred, and instead had to do so out of necessity.

We tested this idea by examining how disruptions to one’s exercise routine impacted affective experiences while exercising during the early stages of COVID-19 (i.e., were these experiences perceived as more or less positive/negative than before the pandemic), and in turn, how changes in affective experiences related to declines in PA. We proposed a moderated mediation model (with parallel mediators; illustrated in Figure 1) which posits that perceived changes to positive and negative affective experiences during exercise mediate the association between perceived disruption to one’s exercise routine and self-reported declines in PA. We predicted that people who perceived greater disruption to their prior exercise routines would perceive less positive affect and more negative affect during exercise (compared to before restrictions). Prior work has found remembered affect to be predictive of exercise engagement (vs. anticipated and experienced affect; Kwan et al., 2017) and that people base deliberate decision-making about behavior on recollections of past affective experiences rather than actual affective experiences (Kahneman et al., 1993). Thus, we predicted that less positive/more negative affect would be associated with greater declines in PA. We also reasoned that those who have high intrinsic motivation to exercise are likely to have exercise routines that foster positive affect (i.e., they exercise in a way that elicits enjoyment, excitement, interest), and thus might be more sensitive to contexts that restrict those routines and affective experiences. Accordingly, we expected the mediation pathways to be moderated by intrinsic motivation, such that those with higher (vs. lower) intrinsic motivation whose routines were highly disrupted would perceive the greatest changes to their affect (largest decreases in positive affect and increases in negative affect), thus contributing to the largest PA declines.

2. Method

2.1. Participants

The data for this study is taken from a larger data set on COVID-19 and PA (Furman et al., 2021; Volz et al., 2021). The full study was approved by the Institutional Review Board of the University of Minnesota and is pre-registered on the Open Science Framework (OSF; https://osf.io/76pdz/).1 To obtain a nationwide sample and ensure adequate power, we aimed to recruit 500 participants. This sample size is above the sample size (n = 171) indicated by G*Power (Version 3.1) to detect a small effect (Cohen’s $f = 0.10$, power = .90, α = 0.05) for the most robust analysis in the full study’s registered analyses.

Participants were recruited through Amazon’s Mechanical Turk (MTurk) between April 21st and May 11th, 2020. A brief prescreening measure first ensured that participants lived in the United States and that prior to changes brought about by COVID-19, they exercised at least three days a week for a total of 150–1200 min of moderate to vigorous PA (MVPA) on a typical week. This sample was appropriate to test our research question as highly active individuals report having higher levels of intrinsic motivation for PA (Teixeira et al., 2012) and were the people that reported the steepest declines in MVPA during COVID-19 (Fearnbach et al., 2021; McCarthy et al., 2021). Participants who passed this prescreening measure were provided with a link to complete the full survey. Those who failed attention checks (n = 26), reported an age under 18 years (n = 1), reported less than 150 min of engagement in MVPA prior to COVID-19 in the more detailed measures in the full survey (n = 105), or were missing one or more measures of interest for analyses (n = 1) were excluded, for a final sample of 373 (67% Caucasian; 51% male; $M_{\text{age}} = 28.86$, $SD_{\text{age}} = 10.00$; a more detailed summary of sample characteristics are available on the OSF project page).

2.2. Measures

Self-reported physical activity. Participants read descriptions of light, moderate, and vigorous intensity PA. For each of these three intensities, participants indicated how many minutes they exercised during a typical week prior to COVID-19 (with the reference point of February 2020) and during COVID-19 (in the last seven days, from April to May 2020). Moderate to vigorous physical activity (MVPA) was calculated by summing moderate intensity minutes plus two times vigorous intensity minutes, with a minimum cutoff of 150 MVPA minutes prior to COVID-19 for inclusion. Participants reported engaging in an average of 381.48 (SD = 335, IQR = 240, SD = 183.46) weekly minutes of MVPA prior to changes brought about by COVID-19 and reported an average decline of 157.44 (SD = 120, SD = 261.49) weekly minutes during COVID-19.

Perceived disruption to exercise routine. Participants responded to one question regarding how much the changes brought about by COVID-19 (e.g., social distancing, closure of gyms) disrupted their exercise routine. The item was reverse coded for ease of interpretation ($M = 3.90$, $SD = 1.22$).

BREQ-2 (Intrinsic motivation subscale). Participants reported their intrinsic motivation using the intrinsic subscale of the Behavioral Regulation in Exercise Questionnaire (Markland & Tobin, 2004), they responded to four questions (e.g., “I enjoy my exercise sessions”) on a 5-point scale (1 = not at all true of me, 5 = very true for me); responses to the four items were averaged for each individual’s intrinsic motivation score ($M = 3.90$, $SD = 0.87$, $\alpha = 0.89$).

Physical Activity Affect Scale. Participants completed the Physical Activity Affect Scale (PAAS; Lox et al., 2000). To test our hypotheses, we utilized the positive and negative affect subscales, each of which include three items that assess one’s positive affect (upbeat, energetic, enthusiastic; $M = 2.52$, SD = 0.96, $\alpha = 0.86$) and negative affect (miserable, discouraged, crummy; $M = 3.14$, SD = 0.93, $\alpha = 0.83$) during PA. To assess perceived changes in affect, they were asked to indicate the extent to which each affective word described how they most often felt during their workouts at the time of the survey, as compared to during their workouts prior to changes brought about by COVID-19 (1 = I feel much less, 5 = I feel much more).

2.3. Procedure

Participants who qualified for the full study completed an informed consent, followed by a series of questionnaires (including measures for perceived disruption to exercise routine, self-reported MVPA, intrinsic motivation for exercise, and the PAAS), and were debriefed.

2.4. Data analytic plan

We tested the proposed moderated mediation model (with parallel mediators) using Hayes (2022) PROCESS Procedure for SPSS Version 4.1. Using Model 7 (moderated mediation with parallel mediators), decline in MVPA was entered as the dependent variable (Y), perceived disruption to exercise routine was entered as the independent variable (X), perceived change in positive affect (M1) and perceived change in negative affect (M2) were entered as parallel mediators, and intrinsic motivation for exercise was entered as a moderator (W). Perceived disruption to exercise routine and intrinsic motivation for exercise were mean-centered prior to analyses. We specified a 95% level of confidence for all confidence intervals in the output and ran 5000 bootstrap samples.
for percentile bootstrap confidence intervals.

The full model illustrated in Figure 1 comprises three regression sub-models. Model 1 regresses perceived change in positive affect (M1) on perceived disruption to exercise routine (X), intrinsic motivation for exercise (W), and the interaction between the two (XW). The regression slope for XW reflects the moderating effect of intrinsic motivation on the pathway between perceived disruption and change in positive affect (path a1). Model 2 regresses perceived change in negative affect (M2) on perceived disruption to exercise routine (X), intrinsic motivation for exercise (W), and the interaction between the two (XW). The regression slope for XW reflects the moderating effect of intrinsic motivation on the pathway between perceived disruption and change in negative affect (path a2). Model 3 regresses declines in MVPA onto perceived disruption to exercise routine, perceived change in positive affect, and perceived change in negative affect. Figures of each sub-model can be found in supplementary materials on the OSF project page (https://osf.io/76pdz/).

### 3. Results

All variables were normally distributed. On average, participants perceived high disruption to their exercise routines and reported declines of nearly 160 weekly minutes of MVPA. They also reported, on average, that they experienced less positive affect while exercising during COVID-19 (vs. before), but that their negative affect was about the same.

The associations between perceived disruption to exercise routine and perceived change in positive and negative affect were moderated by intrinsic motivation (see Table 1 for coefficients in Model 1 and Model 2, respectively). Tests of conditional effects indicated that greater perceived disruption was associated with feeling less positive affect and more negative affect during exercise, and that these effects became stronger as one’s level of intrinsic motivation increased (Table 2).²

Perceived disruption to one’s exercise routine was significantly associated with decline in MVPA (\(B = 84.44, p < .001; c\) path). This association was partially mediated (\(B = 61.92, p < .001; c'\) path). There was evidence for moderated mediation through positive affect, 95% CI 1.92, 16.05). Tests of conditional indirect effects indicated that there was a significant indirect effect at each level of intrinsic motivation (Table 3). Greater disruption was associated with less positive affect during exercise which was associated with larger declines in MVPA, and this indirect effect was the strongest for those with high levels of intrinsic motivation. There was no evidence for moderated mediation through negative affect, 95% CI [−11.41, 0.23].

### 4. Discussion

The COVID-19 pandemic altered daily life in the United States and disrupted how people engage in PA. In this nationwide sample, participants perceived moderate to high levels of disruption to their exercise routines, which was associated with substantial declines to their MVPA engagement. Findings revealed a partial moderated mediation of this association through positive affect: participants who perceived greater

#### Table 2

Conditional effects of perceived disruption on positive and negative affect at values of intrinsic motivation.

| Intrinsic Motivation | Effect | SE  | t  | p   |
|----------------------|--------|-----|----|-----|
| **Predicting positive affect** |         |     |    |     |
| 16th percentile      | −0.31  | 0.05| 6.53| <.001|
| 50th percentile      | −0.40  | 0.03| 11.58| <.001|
| 84th percentile      | −0.50  | 0.05| 9.28| <.001|
| **Predicting negative affect** |         |     |    |     |
| 16th percentile      | 0.15   | 0.05| 2.96| <.001|
| 50th percentile      | 0.31   | 0.04| 8.38| <.001|
| 84th percentile      | 0.47   | 0.06| 8.24| <.001|

² The coefficient representing the association between perceived changes to negative affect and declines in MVPA in Table 2 may be negative due to a suppressor effect. Perceived changes to positive and negative affect are highly correlated, and the zero-order correlation between perceived changes to negative affect and declines in MVPA is positive (i.e., greater negative affect is associated with more decline). A correlation matrix with zero-order correlations between all variables of interest is included in supplemental materials on the OSF project page.

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**Table 1**

Pathway coefficients for the moderated mediation model with parallel mediators illustrated in Figure 1.

| Model | Coefficient | SE  | t    | p   |
|-------|-------------|-----|------|-----|
| **Model 1 (a1 path; R² = .29)** |         |     |      |     |
| Constant | 2.53      | .04 | 60.02| <.001|
| Disruption | −.40     | .03 | −11.41| <.001|
| Intrinsic Motivation | .21      | .05 | 4.28 | <.001|
| Interaction | −.10     | .04 | −2.63| .009|
| **Model 2 (a2 path; R² = .18)** |         |     |      |     |
| Constant | 3.13      | .04 | 70.82| <.001|
| Disruption | −.29     | .04 | 8.01 | <.001|
| Intrinsic Motivation | −.04     | .05 | −.83 | .409|
| Interaction | .16      | .04 | 4.16 | <.001|
| **Model 3 (c’ path; R² = .29)** |         |     |      |     |
| Constant | 460.21    | 78.31| 5.88 | <.001|
| Positive Affect | 61.92    | 9.00 | 6.88 | <.001|
| Negative Affect | −81.23   | 15.36| −5.29| <.001|
| Constant | −31.34    | 14.76| −2.12| .034|
disruption to their exercise routines reported experiencing less positive affect when exercising during COVID-19, which was associated with greater declines in MVPA, and this relation was the strongest for those with higher levels of intrinsic motivation. Those with higher intrinsic motivation also reported experiencing more negative affect while exercising during COVID-19 as perceived disruption increased, but there was no evidence to support moderated mediation of declines in MVPA through negative affect.

These findings support our reasoning that intrinsic motivation may not support PA engagement in situations when exercise does not elicit positive affective experiences and might explain why recent studies have not found intrinsic motivation to be protective against physical activity declines during COVID-19 (see Petersen et al., 2021; Rhodes et al., 2020; Teran-Escobar et al., 2021; Volz et al., 2021). Furthermore, findings revealed that there may even be affective repercussions in these situations, especially for individuals who typically exercise for inherent rewards (e.g., enjoyment, interest). If one cannot exercise in a way that produces these inherent rewards, a lapse in motivation may occur that undermines continued engagement in PA. However, other sources of motivation, such as finding exercise to be important or valuable to one’s goals (i.e., identified regulation), may help to forestall declines in PA in contexts that disrupt one’s routine or that are less preferred (see Nogg et al., 2021; Volz et al., 2021). Given the diverse health benefits of regular PA engagement (U.S. Department of Health and Human Services, 2018), future research should examine if multiple sources of motivation for PA are needed to consistently drive engagement in different contexts, especially those in which positive affective experiences are less likely to occur.

Several limitations of this study should be considered when interpreting results. First, the data is based on retrospective self-reports, which can be prone to biases and limit inferences about causality. This work could benefit from consideration alongside research using longitudinal and objective assessments of PA and its predictors, and momentary assessments of affect during exercise. Second, the PAAS does not capture the entire range of affective states one may experience during exercise, and, thus, this measure may not have fully captured changes to one’s affective experiences when exercising during the early stages of the pandemic, such as physical activity’s ability to reduce negative incidental affective states (e.g., general stress, fatigue). Future work using alternate measures of affect—for example, assessing core affective valence (e.g., good/pleasure vs. bad/displeasure) instead of specific affective states (e.g., energized, bored; Crispim et al., 2015)—is required to determine the full scope of the impact of contextual disruption on affective experiences relevant to exercise. Finally, one should be mindful of the demographics of and the source of the current sample. Two-thirds of the participants were Caucasian, the majority were college-educated, and they were younger than the average adult US population. Moreover, this study focused solely on a sub-sample of MTurk workers who were engaging in recommended levels of PA prior to changes brought about by COVID-19. Follow-up research could examine how contextual disruption impacts affective experiences for those with varying levels of intrinsic motivation and PA engagement to determine if there are conditions under which disruption of routines may yield different results.

5. Conclusion

The literature strongly supports intrinsic motivation as a determinant of sustained engagement in PA, but current findings suggest that there may be affective repercussions that undermine PA engagement when one cannot exercise in the way that one prefers. Although our inferences are limited by the cross-sectional nature of the data, these findings highlight the need to further examine contexts in which intrinsic motivation may not facilitate behavioral engagement and why. This work also contributes to a growing body of literature on predictors of PA during COVID-19 (Petersen et al., 2021; Rhodes et al., 2020; Volz et al., 2021) which collectively suggest that complexity in motivation (i.e., having several reasons for engaging in a behavior) may help to forestall declines in PA during periods of disruption.

Declaration of interest

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

Data availability

The data/code for this paper is publicly available on the Open Science Framework Project Page

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jsypsych.2022.102330.

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