Online Supplemental Material (OSM) for

Perceived social integration predicts future physical activity through positive affect and spontaneous thoughts

Diagnostics and Model Assumptions

Growth Models

Visual inspection of weekly means for social integration and positive affect during physical activity revealed linear trends. Both variables were first separately submitted to univariate linear growth curve analysis with a homoscedastic error structure. Then, analogous models were estimated that allowed for heteroscedastic error variances over time. Likelihood ratio tests were conducted to determine whether allowing for differing residual variance at each time point improved model fit.

In the case of social integration, the likelihood ratio test revealed that the heteroscedastic error structure improved model fit ($X^2 = 467.9$, $df = 76$, $p < .001$). In that model, time was positively associated with social integration scores ($b = 0.036$, $SE = 0.007$, $p < .001$), suggesting that perceptions of social integration increased over the 11 weeks. The same pattern emerged for positive affect during physical activity. The likelihood ratio test revealed that the heteroscedastic error structure improved model fit ($X^2 = 337.1$, $df = 76$, $p < .001$). In that model, time was positively associated with positive affect during physical activity ($b = 0.01$, $SE = 0.005$, $p = .036$), suggesting that positive affect experienced during physical activity increased over the 11 weeks.

Visual inspection of weekly means for daily physical activity revealed an initial spike and drop-off, followed by a more approximately linear trend after the several weeks of the daily measures. A quadratic growth curve model revealed a statistically significant quadratic effect (*b*

= .24, *SE* = .06, $p < .001$), however, visual inspection of model-implied individual trajectories revealed that the quadratic effect may have been driven by extreme peaks and drop-offs by a few participants, whereas the trajectories for most participants appeared reasonably linear. As such, we chose to exclude the first two weeks of data and submit daily physical activity data from weeks 3 through 11 to two linear growth models: one with homoscedastic residual variance and the other with heteroscedastic residual variance. A likelihood ratio test revealed the that model with heteroscedastic residual variance yielded vastly improved model fit ($X^2 = 1643$, $df = 76$, $p < .001$). In that model, time was not significantly associated with daily minutes of physical activity ($b = 0.17$, *SE* = 0.22, $p = .44$, 95% CI = [-0.26, 0.59]).

Path Analysis

Preliminary examination of the present data enabled reasonable confidence in the key assumptions underlying maximum-likelihood estimation and path modeling. Given that the present research involved secondary analysis of previously collected data, a priori analyses to determine an optimal sample size were not possible (though such analyses were conducted in anticipation of primary analyses unrelated to the present research). Data cleaning and reduction yielded a final sample size of 147 participants, which is a sufficient sample size for testing a model including six variables (and ten paths among them), according to several conventions for determining minimum acceptable sample sizes as a function of model complexity (e.g., Bollen, 1989). As described in the main text, in cases where participants provided multiple valid cases, only the first complete case was included in the analysis sample, so there were no repeated measures among participants, consistent with the assumption of independent residuals.

Path analysis also assumes that the residuals pertaining to the endogenous variables in the model are multivariate normally distributed. Visual inspection of residual plots revealed no egregious violations of this assumption. The distribution of residuals from the effect of positive spontaneous thoughts on duration of physical activity demonstrated positive skewness, but conventional power transformations (e.g., square root, logarithm) did not improve the distribution, and as such, the raw data were retained. Visual inspection of the raw data revealed no nonlinear trends. In sum, we determined that submitting the data in their current form to path analysis seemed to be a reasonable strategy.

Beyond the primary assumptions of path analysis, we also explored the distributions of all variables included in the model to identify any extreme values. The data on positive spontaneous thoughts included three mild outliers on the low end of the scale, and the data on duration of physical activity three mild outliers on the high end of the range. Excluding the three cases with high values of physical activity did not substantially alter model fit (X^2= 12.67, *df* = 9, *p* = .18, RMSEA = 0.053, CFI = 0.94, SRMR = 0.055), and the hypothesized paths remained statistically significant. However, excluding the three cases with low values of positive spontaneous thoughts yielded a somewhat poorer fitting model (X^2= 15.96, *df* = 9, *p* = .07, RMSEA = 0.073, CFI = 0.87, SRMR = 0.064), although the hypothesized paths remained statistically significant.

Other Healthy Behaviors

A major focus of the present paper was to explore one pathway through which social integration may influence physical activity, following the specifications of the upward spiral theory of lifestyle change. However, the upward spiral theory is not specific to the domain of physical activity, and measures of other health-related behaviors (i.e., smoking, drinking alcohol, eating fruits and vegetables, meditating) were included in the original study that provided the data for this secondary analysis. As explained elsewhere (Van Cappellen, Rice, Catalino, &

Fredrickson, 2017), the upward spiral theory of lifestyle change may be better suited for modeling health-promoting behaviors than behaviors that pose a risk to health, and as such, we chose not to explore the present hypotheses pertaining to social processes and affect in the contexts of smoking or drinking alcohol. Further, although meditation has the potential to produce positive emotions (Fredrickson et al., 2017) and promote health (Carlson et al., 2015; Hilton et al., 2017; Keng, Smoski, & Robins, 2011), we felt the current test of the upward spiral theory – with social integration as a vantage resource enacted as sociality during the focal behavior – would not be well suited to meditation, which may frequently be practiced as a solo activity; indeed, a paired *t*-test confirmed that the mean value of sociality during meditation in the full sample (M = 0.66, SD = 0.82) was lower than the mean value of sociality during physical activity (M = 1.29, SD = 0.87), $t(211) = 10.28$, $p < .001$.

However, eating fruits and vegetables – the remaining other behavior in the dataset – is a health-promoting behavior that may be experienced as a social activity, so we attempted a conceptual replication of the model in that domain. In that analysis, we followed the same data reduction process described in the main text and tested an analogous model to the final model reported in the paper, with the measures of sociality, positive affect, and positive spontaneous thoughts referring to eating a nutritious meal, and the final outcome variable representing the amount (in cups) of fruit and vegetables consumed over a 48-hour period. Path analysis in Mplus 7.4 revealed poorer model fit (X^2= 16.14, df = 10, p = .10, RMSEA = 0.06, CFI = 0.88, SRMR = 0.06), thus we did not interpret the individual paths. No modification indices emerged to suggest altering the path model, though inspection of individual paths in separate regression analyses revealed significant effects at each step of the hypothesized model.

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