# Inconsistent Curiosity: Augmentation and Blunting of Curiosity in Daily Life and Implications for Well-Being

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**Abstract**

Curiosity promotes focused engagement in novel and challenging situations and the accruement of resources that promote well-being. A critical open question is the extent to which curiosity lability, the degree to which curiosity fluctuates over short timescales, impacts well-being. We use data from a 21-day daily diary protocol as well as trait measures collected prior to the daily diary in 167 participants (mean age = 25.37 years, *SD* = 7.34) to test (i) the importance of curiosity lability for depression, flourishing, and life satisfaction, (ii) day-to-day associations among curiosity and happiness, depressed mood, anxiety, and physical activity, and (iii) the extent to which day's mood acts as a mediator between day's physical activity and day's curiosity. Regression analyses indicate positive associations among curiosity lability and depression, as well as negative associations among curiosity lability and life satisfaction, above and beyond trait curiosity. No evidence for an association between curiosity lability and flourishing emerge when controlling for trait curiosity. Multilevel model results indicate that curiosity is higher on days of greater happiness and physical activity, and that curiosity is lower on days of greater depressed mood. We observe no association between curiosity and anxiety. Multilevel mediation models indicate evidence consistent with day's depressed mood and happiness as mediators between physical activity and curiosity. In sum, we find that greater consistency in curiosity is associated with well-being, identify several sources of augmentation and blunting of curiosity in daily life, and provide support for purported mechanisms linking physical activity to curiosity via mood.

Keywords: curiosity; depressed mood; positive affect; daily diary; well-being

## Significance Statement

Curiosity promotes focused engagement in novel and challenging situations and, in the process, the accruement of psychological and social resources that promote well-being. We demonstrate that the extent to which one *consistently* reports feeling curious during the course of daily life is associated with life satisfaction and depression, above and beyond trait curiosity. The findings emphasize the importance of considering dynamics in curiosity and, by observing within-person associations among curiosity, depressed mood, happiness, and physical activity, begin the task of identifying potential sources of augmentation and blunting of curiosity in daily life that may be targeted to realize consistent curiosity.

## INTRODUCTION

Curiosity is the propensity to seek out novel, complex, and challenging interactions with the world (1, 2). Curiosity facilitates engagement with unfamiliar information (3), even if that information challenges existing beliefs and instills uncertainty (4). States of curiosity are functional; they facilitate the coordination of physiological states associated with concentration and approach-oriented action (5, 6) and they are associated with increased motivation to expand one's knowledge and skills (7). Curiosity, by promoting focused engagement in novel and challenging situations and, in the process, the accruement of psychological and social resources (8), may promote well-being (9, 10). Indeed, trait curiosity is positively associated with life satisfaction and well-being (11-13) and negatively associated with depression (14, 15).

Importantly, it is through *consistently* acting on curious feelings that high trait curiosity is theorized to build competencies and, in turn, promote well-being (16). The time-varying nature of curiosity, especially its transience, has been long-noted (2) and daily (or finer timescale) fluctuations in curiosity and their implications for the day-to-day engagement in growth-oriented behaviors are increasingly the subject of scientific investigation (1, 17, 18). Yet, important questions remain unanswered about how fluctuations in curiosity impact well-being. We examine the extent to which curiosity lability, which we define as the extent to which curiosity fluctuates on fine timescales (see also 19, 20), is associated with well-being. We hypothesize that enduring states of curiosity, reflecting the consistent experience of curiosity theorized to promote exploration and the building of competencies and skills, are associated with greater well-being. In contrast, we hypothesize that fragile curiosity, reflecting relatively greater changes in the experience of curiosity from day-to-day and less consistent growth-promoting behaviors, is associated with lower well-being.

In addition to examining associations among curiosity lability and well-being, we examine potential sources of augmentation and blunting of curiosity in daily life. In line with perspectives that positive emotions motivate the drive-free exploration that characterizes curiosity (21), we test the hypothesis that days of higher than usual happiness are associated with higher than usual curiosity. Mood induction experiments, in contrast, indicate that depressed mood reduces curiosity and the desire for knowledge (22). As such, we test the hypothesis that days of higher than usual depressed mood are associated with lower than usual curiosity.

As an exploratory aim, we also examine curiosity's association with anxiety, given the long-standing debate over their relationship. Due in great part to the Latin sense of *cura* as meticulous, painstaking, even obsessive care (23), curiosity and anxiety have been densely intertwined historically, promulgating the notion that curiosity "has always an appearance of giddiness, restlessness, and anxiety" (24, p.31). Early psychological theories proposed that curiosity may result from the identification of contradictions and ambiguities that leads to an unpleasant feeling some have interpreted as anxiety (25-27). Later theories described curiosity and anxiety as distinct drives (28,29). More contemporary state-trait models of curiosity were drawn from state-trait models of anxiety (30,31). In contrast to frameworks positing a positive association between anxiety and curiosity, other work highlights that anxiety may interfere with the exploratory behavior characteristic of curiosity (9, 32) or, conversely, that curiosity functions as an antidote to anxiety (33).

Finally, we examine the association between physical activity and curiosity in daily life. Physical activity is associated with curiosity at the between-person level, with high exercisers relative to low exercisers exhibiting higher curiosity (34). This finding is commonly interpreted in terms of physical activity's effects on mood, with physical activity associated with increased

positive and decreased negative mood (35-37). We significantly extend this prior work by examining within-person processes to determine if days of higher than usual physical activity are also days of higher than usual curiosity. Moreover, we directly test the extent to which mood acts as a mediator between physical activity and curiosity in daily life.

In testing these hypotheses, we show that individuals with relatively greater curiosity lability – greater day-to-day fluctuations in curiosity over the course of 21 days – report relatively lower life satisfaction and more symptoms of depression, providing support for frameworks emphasizing the importance of consistent curiosity for promoting well-being. Notably, these associations are significant when controlling for trait curiosity, suggesting the importance of capturing dynamics in curiosity above and beyond trait measures for understanding well-being. We also show that days of higher than usual curiosity are also days during which participants experience higher than usual happiness and physical activity, and lower than usual depressed mood. Finally, we show that the within-person association between physical activity and curiosity on a daily timescale is partially mediated via physical activity's associations with happiness and depressed mood. In sum, our findings highlight the importance of considering daily fluctuations in curiosity for understanding well-being, identify several potential sources of augmentation and blunting of curiosity in daily life, and provide support for purported mechanisms linking physical activity to curiosity.

## RESULTS

We study trait curiosity, depression, flourishing, and life satisfaction as assessed by the Curiosity and Exploration Inventory-II (4), the Center for Epidemiological Studies Depression Scale (38), the Flourishing Scale (39), and the Life Satisfaction scale (40). These scales assess

how participants *generally* feel and behave. In addition, we study day's curiosity, depressed mood, anxiety, happiness, and physical activity. In contrast to the trait reports, we assess these daily variables using end-of-day reports as part of a 21-day daily diary protocol, using scales adapted to capture day-to-day variability in curiosity (18), depressed mood, anxiety, and happiness (41), and physical activity (42). We provide descriptive statistics for the variables used in the analyses in Table 1. Out of a possible total of 3507 daily diary days (21 days x 167 participants), 3141 (89.56%) were available. The number of daily diary days available per participant ranged from 11 to 21 ($M$ = 18.81, $SD$ = 2.75).

An important initial question is the extent of variability in the daily diary variables that could be attributed to within-person versus between-person variance. Intraclass correlations calculated on the time series from the daily diary reports of curiosity, happiness, depressed mood, anxiety, and physical activity reveal substantial variance attributable to day-to-day, within-person variation. The lowest proportion of variance associated with within-person variability is 0.47 for curiosity and the highest proportion is 0.58 for physical activity.

**Curiosity Lability and Associations with Well-Being Above and Beyond Trait Curiosity**

We sought to test the importance of consistency in curiosity for well-being. We used multiple regression analysis (Table 2) to test if curiosity lability was positively associated with depressive symptoms, above and beyond trait curiosity and covariates (age, gender, and number of days of the daily diary protocol that were completed). The results indicate that the predictors explain 9% of the variance in depressive symptoms as assessed during the baseline session ($R^2$=0.09, $F$(6, 159)=2.61, $p$=0.02). Curiosity lability is positively associated with depression ($\beta$=0.16, $p$=0.04) such that participants with relatively high day-to-day variation around their mean in their daily diary reports of curiosity also reported greater symptoms of depression

(Figure 1A). Notably, trait curiosity is not uniquely associated with symptoms of depression ($\beta$=-0.02, p=0.73) as shown in Figure 1B. Neither age nor number of days of daily diary data available is associated with depression (all $p$-values > 0.05). Participants self-identifying as other gender reported more depression relative to females ($\beta$=0.82, $p$=0.008).

We used multiple regression analysis to test if curiosity lability was negatively associated with flourishing, above and beyond trait curiosity and covariates (age, gender, and number of days in the study). The results indicate that the predictors explain 14% of the variance in flourishing ($R^2$=0.14, $F$(6, 159)=4.20, $p$<0.001). Although zero-order correlations are in line with our hypotheses, indicating negative associations between flourishing and curiosity lability ($r$ = -0.18, $p$=0.02), curiosity lability is not significantly associated with flourishing when accounting for covariates ($\beta$=-0.26, $p$=0.06; Figure 1C). Notably, trait curiosity is associated with flourishing ($\beta$=0.27, p=0.003), such that participants reporting greater trait curiosity, also report greater flourishing (Figure 1D). Neither age nor number of days of daily diary data available is associated with flourishing (all p-values > 0.05). Males report lower flourishing relative to females ($\beta$=-0.36, $p$=0.02).

We used multiple regression analysis to test if curiosity lability was negatively associated with life satisfaction, above and beyond trait curiosity and covariates (age, gender, and number of days in the study). The results indicate that the predictors explain 13% of the variance in life satisfaction ($R^2$=0.13, $F$(6, 159)=4.13, $p$<0.001). Curiosity lability is negatively associated with life satisfaction ($\beta$=-0.71, $p$=0.002), such that participants with relatively high day-to-day variation around their mean daily reports of curiosity report less life satisfaction (Figure 1E). Notably, trait curiosity is not uniquely associated with life satisfaction ($\beta$=0.04, $p$=0.81; Figure 1F). Neither gender nor number of days of daily diary data available is associated with life

satisfaction (all p-values > 0.05). Age is negatively associated with life satisfaction ($\beta$=-0.04, $p$=0.001), such that older participants report lower life satisfaction.

**Associations with Day-to-Day Variability in Curiosity**

Based on our findings that curiosity lability is important for well-being, we used a multilevel model to examine the factors associated with day-to-day, within-person variability in curiosity during the course of daily life (Table 3). Days of higher than usual curiosity are also days of higher than usual happiness ($\beta$=0.34, $p$<0.001; Figure 2A), lower than usual depressed mood ($\beta$=-0.10, $p$=0.003; Figure 2B), and higher than usual physical activity ($\beta$=0.02, $p$<0.001; Figure 2D). Day's anxiety is not significantly associated with day's curiosity ($\beta$=0.05, $p$=0.05; Figure 2C). Person-level characteristics associated with higher than usual levels of curiosity across the 21 days of the daily diary protocol included higher than usual happiness ($\beta$=0.53, $p$<0.001) and higher than usual physical activity ($\beta$=0.08, $p$<0.001). Neither usual levels of depressed mood, anxiety, age, nor gender are associated with usual levels of curiosity in daily life (all p-values > 0.05).

**Physical Activity's Positive Association with Curiosity is Partially Mediated via Physical Activity's Association with Depressed Mood and Happiness**

Based on the finding that day's physical activity is associated with day's curiosity, we ran mediation models to examine whether physical activity's association with happiness and depressed mood could explain this association. We present the results from the mediation model examining within-person associations among physical activity, happiness, and curiosity in Table 4 and in Figure 3A. There are significant associations between physical activity and happiness ($\gamma_{a0}$=0.04, $p$<0.001), happiness and curiosity ($\gamma_{b0}$=0.35, $p$<0.001), and physical activity and

curiosity ($\gamma_{c'0}$=0.03, $p$<0.001). The associations are in the expected direction, with greater than usual physical activity associated with greater than usual happiness, greater than usual happiness associated with greater than usual curiosity, and greater than usual physical activity associated with greater than usual curiosity. The estimated average indirect effect is 0.012 (*SE* = 0.003, $p$<0.001) and the estimated average total effect of physical activity on curiosity is 0.038 **(***SE* = 0.01, $p$<0.001). Thus, the findings are consistent with partial mediation with about 32% of the association between physical activity and curiosity mediated through physical activity's association with happiness.

We present the results from the mediation model examining within-person associations among physical activity, depressed mood, and curiosity in Table 5 and in Figure 3B. There are significant associations between physical activity and depressed mood ($\gamma_{a0}$=-0.01, $p$=0.003), depressed mood and curiosity ($\gamma_{b0}$=-0.23, $p$<0.001), and physical activity and curiosity ($\gamma_{c'0}$=0.03, $p$<0.001). The associations are in the expected direction, with greater than usual physical activity associated with lower than usual depressed mood, greater than usual depressed mood associated with lower than usual curiosity, and greater than usual physical activity associated with greater than usual curiosity. The estimated average indirect effect is 0.004 **(***SE* = 0.002*, p*=0.04) and the estimated average total effect of physical activity on curiosity is 0.037 (*SE*=0.01, $p$<0.001). Thus, the findings are consistent with a partial mediation account, with about 11% of the association between physical activity and curiosity mediated through reductions in depressed mood.

## Discussion

Curiosity promotes engagement with novel and challenging stimuli and situations, leading to the accruement of resources, and promoting well-being. It is through consistently

acting on one's curiosity that high trait curiosity is thought to promote well-being (16), necessitating a consideration of the extent to which curiosity lability, fluctuations in curiosity over the time scale of days, and a measure of inconsistency in one's curiosity, may undermine well-being. We quantified between-person differences in curiosity lability over the course of 21 days and tested the associations between curiosity lability and depression, life satisfaction, and flourishing. Consistent with the hypothesized importance of consistent curiosity in promoting well-being, individuals with relatively greater fluctuations in curiosity around their average level of curiosity during the daily diary protocol had decreased life satisfaction, decreased flourishing, and increased depression. Notably, the association between curiosity lability and both life satisfaction and depression was significant above and beyond a trait measure of curiosity, indicating the added value of considering dynamics in curiosity for understanding well-being.

After revealing the importance of within-person fluctuations in curiosity for well-being, we examined the extent to which happiness, depressed mood, anxiety, and physical activity acted as potential sources of augmentation and blunting of curiosity in daily life. In line with previous laboratory findings (22) and perspectives that positive emotions motivate exploration (21), we observed that days of higher than usual depressed mood were associated with lower than usual curiosity, and that days of higher than usual happiness were associated with higher than usual curiosity. These results suggest that negative associations among depressed mood and curiosity generalize to ecologically valid, naturalistic fluctuations in mood and curiosity occurring during the course of daily life.

Within-person variability in anxiety was not associated with changes in curiosity. Anxiety has been viewed as both associated with the pursuit of curiosity and the identification of contradictions and ambiguities (27) and a factor that may interfere with the exploratory behavior

characteristic of curiosity (9). The contrasting associations among anxiety and curiosity may be differentially present prior to curiosity-driven exploration and during the process of curiosity-driven engagement with novel stimuli and situations. Testing these distinct pathways will require repeated measures at more fine-grained timescales than were available in the daily diary reports in the present study.

We replicate previously observed between-person associations among curiosity and physical activity (34), with higher levels of average physical activity across the 21-day daily diary protocol associated with higher levels of average curiosity. In addition to replicating this between-person finding, our collection of intensive repeated measures allowed us to disentangle within-person and between-person associations among physical activity and curiosity and to demonstrate that the association among physical activity and curiosity was also evident at the within-person level, with days of greater than usual physical activity associated with greater than usual curiosity. Results of the within-person mediation analyses are consistent with frameworks suggesting that physical activity's association with curiosity is mediated via physical activity's effects on positive and depressed mood (35-37). We note, however, that we observed evidence for partial mediation, with substantial direct associations among physical activity and curiosity remaining unexplained by depressed mood and happiness. Further study of physical activity using modes, scales, and intensities titrated to disabled bodies, moreover, could deepen and extend the present study to account for a population significantly understudied in the literature on curiosity.

An additional finding of interest was that participants self-identifying as other gender reported more depression relative to females. This finding confirms existing literature, although we caution that only 2 participants self-reported as other gender. We broadly define those who

selected “other gender” as falling within the larger trans* or transgender umbrella, which includes gender non-conforming, non-binary, and agender individuals (43,44). This population is known to experience higher rates of depression relative to their nontransgender counterparts. Transgender suicide attempt rates, for example, are nine times the national average (45), often worst among transmasculine youth (46). Predictors of depression among transgender people, exacerbated by intersections of race, gender, class, and sexuality (47), include minority stress, low self-esteem, overt discrimination and victimization, lack of social support, and little or no access to medical transition technologies where desired (48-50). Given higher rates of depression and lower rates of physical activity (51), the study of curiosity within trans populations requires further study (52).

**Limitations and Future Directions**

It is important to consider the findings in light of the study’s strengths and limitations. Our use of daily diaries allowed us to capture naturally-occurring variation in curiosity during life as it is lived (53). However, the daily diary data are limited in their ability to evaluate temporal precedence. Future work, drawing on multiple occasions (3 or more) each day, will provide greater possibilities to examine putative causal associations and to provide more stringent tests of mediation. In addition, the measurement of curiosity is an active field of research. The everyday behaviors through which curiosity is theorized to lead to the accruement of psychological resources remain to be characterized. Emerging perspectives conceive of curiosity as a knowledge network building practice in which concepts and the connections between them are added and taken away during the intrinsic information-seeking that characterizes curiosity (54, 55). This knowledge network building perspective calls for a greater consideration of everyday curiosity behaviors and presents new tools from network science to

formally study the manner in which curiosity drives knowledge network growth. Work from this perspective will represent an important next step to probe the behaviors that accompany micro-time fluctuations in curiosity highlighted by the present work and that are the building blocks of the shoring up of resources that promote well-being.

**Conclusions**

In summary, the present study extends previous examinations of the association among curiosity and well-being by demonstrating that the extent to which one consistently reports feeling curious during the course of daily life is associated with well-being, above and beyond trait reports of curiosity. The findings emphasize the importance of considering dynamics in curiosity and, by observing within-person associations among curiosity, depressed mood, happiness, and physical activity, begin the task of identifying potential sources of augmentation and blunting of curiosity in daily life that may be targeted to realize consistent curiosity.

## MATERIALS AND METHODS

We made use of data from the Knowledge Networks Over Time (KNOT) study, an intensive longitudinal study designed to provide insight into day-to-day intraindividual variability across a range of domains of functioning, in particular curiosity. Data and code used in the manuscript are available upon request from the corresponding author.

### Participants

Participants were 167 individuals (136 female, 29 male, 2 other gender) recruited through poster, Facebook, Craigslist, and university research site advertisements in Philadelphia and the surrounding university community. Individuals were eligible if they met 4 criteria: 1) aged between 18 and 65 years; 2) consistent access to a computer with internet access at home; 3) willingness to complete 21 consecutive days of surveys; 4) willing to visit the research laboratory for a 1 hour visit. Participants were aged between 18.21 and 65.24 years ($M$ = 25.37, $SD$ = 7.34), and identified as White (49.10%), African American/Black (8.38%), Asian (23.35%), Hispanic/Latino (4.79%), Multiracial (6.59%), other (5.39%), and missing information (2.40%). Participants identified as bisexual (7.78%), gay (4.19%), heterosexual (79.04%), lesbian (1.20%), other (5.99%), and missing information (1.80%). Participants reported a yearly family income ranging from 'under $20,000' to '$200,000 or more' (*Modal income* = '$20,000 - $49,000'). Participants' education spanned less than a high school degree (0.60%), high school degree (8.98%), associate's degree or some college but no degree (30.54%), college degree (37.72%), graduate or professional training (20.96%), or missing information (1.20%).

### Procedure

Interested participants encountering study advertisements were directed to a website with study information and a consent form. After confirming that participants met inclusion criteria,

participants were contacted via telephone with a description of the study and an opportunity to assent or decline participants. If individuals assented, an email was sent with a baseline survey containing demographic questionnaires, the curiosity measure, the depression measure, the life satisfaction measure, and the flourishing scale used in the present study. The baseline survey contained additional scales that were not the focus of the present study. Once the baseline survey was completed, participants completed a laboratory session. At the laboratory session, participants completed additional questionnaires, received training in the daily assessment protocol, and were guided through the installation of an app necessary for an internet browsing study component that we do not report on in the present study. Following the laboratory study, a 21-day diary assessment protocol was initiated. The 21-day diary assessment consisted of two components. The first was a daily diary consisting of survey questionnaires that took approximately 5 minutes to complete. The second came immediately after the daily diary component and was a 15 minute internet browsing task that we do not report on in the present manuscript. Links to the daily assessments were emailed to participants at 6:30 PM each evening. Participants requesting reminders received a text message at 6:40 PM to notify that survey links had been emailed. Participants were instructed to complete the daily assessments before going to bed but that links remained open until 10:00 AM the next morning. Access links remained open until 10:00 AM the next morning. In cases where participants completed the surveys the following morning, they were instructed to report as if they were completing the survey on the previous evening. Daily questionnaires took approximately 5 minutes to complete. Participants were compensated with gift cards to Amazon.com at each study phase: $25 after completing the baseline assessment and the laboratory visit. For the daily assessment, completion was incentivized by making participant payment contingent on completion: completion of 3, 4, 5,

6, and 7 surveys each week was compensated with gift cards worth $10, $15, $20, $25, and $35, respectively. Continued participation through the daily assessment was further incentivized by using a raffle for which an iPad mini was available as a prize. Completion of all 7 surveys each week resulted in one entry into the raffle drawing.

**Measures**

The present study made use of participants' reports of demographic and trait characteristics from the baseline surveys and their daily diary reports.

**Trait Curiosity.** Trait Curiosity was measured using the Curiosity and Exploration Inventory-II (CEI-II; 4). The CEI-II consists of 10-items and measures two dimensions of curiosity with two subscales of 5-items. The stretching subscale measures the extent to which an individual is motivated to seek knowledge and new experiences while the embracing subscale assessing the willingness to embrace the novel, uncertain, and unpredictable nature of everyday life. Items are answered on a scale ranging from 1 (“Very slightly or not at all”) to 5 (“Extremely”). The mean value of all 10 items was taken as a measure of curiosity, with higher values indicating relatively higher levels of curiosity. For the current sample, the measure demonstrated high internal consistency ($\alpha$ = 0.88).

**Flourishing.** Flourishing was measured using an 8-item flourishing scale (39). The flourishing scale contains items related to important aspects of human functioning, including positive relationships, feelings of competence, and having meaning and purpose in life. Flourishing scale items are answered on a 1 (“Strong Disagreement”) to 7 (“Strong Agreement”) scale. The mean value of all 8 items was taken as a measure of flourishing, with higher values indicated relatively higher levels of flourishing. The scale demonstrated high internal consistency in the current sample ($\alpha$ = 0.90).

**Life Satisfaction.** Life satisfaction was measured using the satisfaction with life scale (40). The scale consists of 5 items designed to measure global cognitive judgements of satisfaction with one's life. Items are answered on a scale that ranges from 1 ("Strongly Disagree") to 7 ("Strongly Agree"). The mean value of all 5 items was taken as a measure of life satisfaction, with high values indicating relatively higher levels of life satisfaction. The scale demonstrated high internal consistency in the current sample ($\alpha$ = 0.89).

**Depression.** Depression was measured at the laboratory session using the Center for Epidemiological Studies Depression Scale (38). The scale consists of 20 items. Each item is a symptom associated with depression, and participants rate how often they experienced a particular symptom in the previous week on a scale ranging from 1 ("rarely or none of the time (less than 1 day)") to 4 ("Most or all of the time (5-7 days)"). Four items are reverse coded. The mean value of all 20 items was taken as a measure of depression, with high values indicating higher levels of depression. The scale demonstrated high internal consistency in the current sample ($\alpha$ = 0.90).

**Daily Curiosity.** Daily curiosity was measured during the daily diary component of the study using 2-items from the CEI-II that have been used in previous studies of daily curiosity (e.g., 18). Participants responded to the items "Today, I viewed challenging situations as an opportunity to grow and learn" and "Everywhere I went today, I was out looking for new things or experiences" on a slider ranging from 0 ("Not at all") to 10 ("Very") in increments of 0.1. Responses across the items were summed to form a daily curiosity scale, with higher values indicated higher levels of curiosity.

**Daily Emotion.** Daily emotion was measured using items adapted from the Profile of Mood States (56) of the form "How much of the time today did you feel…?" that have been used

in previous experience-sampling studies (42). Three emotion scales, each consisting of two items – happiness (happy, content), depression (depressed, sad or blue), and anxiety (anxious, worried) – were computed. Participants rated how much they felt each emotion that day using a slide scaled 0 ('None of the time") to 10 ("All of the time") with 0.1 increments.

**Physical Activity.** Daily physical activity was measured using a modified version of the Godin Leisure Time Exercise Questionnaire (LTEQ; 57,58). The LTEQ is a validated measure of adult physical activity (59) and a daily version of this measure has been used in previous experience-sampling studies (43). Participants were asked to rate how many times they engaged in mild exercise (e.g., easy walking, yoga), moderate exercise (e.g., fast walking, volleyball), and vigorous exercise (e.g., running, vigorous swimming). Using the LTEQ scoring procedure, responses were weighted by standard metabolic equivalents (MET; mild activity = 3, moderate activity = 5, vigorous activity = 9) and summed to create a daily MET or energy expenditure score. Higher scores indicated more physical activity energy expenditure.

## Data Analysis

**Calculating the extent of within-person variance in the daily diary measures.** As a first step, intraclass correlations (ICCs) were computed on the daily diary measures to identify the proportion of between-person and within-person variance in each measure. The ICC reflects the amount of between-person variance for a target variable, relative to the total, calculated as

$$ICC = \frac{\tau_{00}}{\sigma^2 + \tau_{00}}, \quad (1)$$

where $\tau_{00}$ is the between-person variance and $\sigma^2$ is the within-person variance. Larger ICC values indicate a higher proportion of total variance at the between-person level, whereas a smaller ICC indicates more within-person variability in the target variable. To compute ICCs for each variable, we fit a random intercept model of the form:

Level 1:

$$TargetVariable_{it} = \beta_0 + e_{it}$$

Level 2:

$$\beta_0 = \gamma_{00} + u_{0i} \quad (2)$$

where $\gamma$ denotes a fixed effect and $u$ denotes a random effect. The *icc* function from the *sjstats* package in R was used to compute the ICC.

**Creating a curiosity lability index.** In order to examine the importance of fluctuations in curiosity for well-being, we computed a curiosity lability score for each individual as:

$$CuriosityLability_i = \frac{\sigma_i}{\mu_i} \quad (3)$$

where $CuriosityLability_i$ is the curiosity lability score for person *i*, $\sigma_i$ is the standard deviation of the curiosity time series from the daily diary of person *i*, and $\mu_i$ is the mean of the curiosity time series from the daily diary of person *i*. Dividing the standard deviation by the mean results in the coefficient of variation, a relative index of the extent to which values of a variable are dispersed around the mean. Higher curiosity lability values indicate greater dispersion around the

mean. The coefficient of variation is commonly used as a measure of intraindividual variability (e.g., 60, 61). A participant with an outlier value on curiosity lability (6.96 standard deviations above the mean) was identified and removed from analyses that used this index.

**Testing associations among curiosity lability and well-being.** We then tested the extent to which curiosity lability was associated with depression, flourishing, and life satisfaction above and beyond trait curiosity (and covariates) in three separate multiple regression models (one for each outcome) of the form (using depression as an example):

$$Depression_i = \beta_0 + \beta_1 TraitCuriosity_i + \beta_2 CuriosityLability_i + \beta_3 Age_i + \beta_4 GenderMale_i + \beta_5 GenderOther_i + \beta_6 NumberOfDays_i \,, \quad (4)$$

where $\beta_0$ is the intercept, indicating the average level of depression for the prototypical female (all predictors were sample-mean centered except for gender which was dummy coded such that female was the reference category), $\beta_1$ is the mean value of the CEI-II scale completed during the baseline survey, $\beta_2$ is the curiosity lability score created by computing the coefficient of variation on each individuals' curiosity time series from the daily diary component of the study (equation 3), $\beta_3$ examines associations among depression and age, $\beta_4$ compares depression values for males relative to females, $\beta_5$ compares depression values for participants reporting other genders relative to females, and $\beta_6$ controls for the number of days of the daily diary data completed by participants.

**Identifying factors associated with day-to-day variability in curiosity.** Once we observed associations among fluctuations in curiosity and well-being, we turned to our next research question concerning the factors associated with day-to-day variability in curiosity. A

multilevel model framework (62) was adopted to accommodate the nested nature of the intensive repeated measures data (21 days nested within 167 persons). In order to facilitate a focus on within-person associations among curiosity and happiness, depressed mood, anxiety, and physical activity, the predictor variables were parameterized to separate within-person and between-person associations by creating time-invariant (between-person) and time-varying (within-person) versions of the predictor variables (see 63). We calculated the time-invariant, between-person variables for *usual happiness*, *usual depressed mood*, *usual anxiety*, and *usual physical activity* as the grand-mean centered individual mean score of happiness, depressed mood, anxiety, and physical activity, respectively, across all days in the daily diary study. Participants with positive values on these between-person variables had greater than usual levels of happiness, depressed mood, anxiety, and physical activity throughout the study compared with other participants in the sample. Participants with negative values on these variables had lower levels of happiness, depressed mood, anxiety, and physical activity. We calculated time-varying, within-person versions of the happiness, depressed mood, anxiety, and physical activity variables as deviations from these between-person means and, thus, zero on these within-person variables indicated days of usual levels of happiness, depressed mood, anxiety, and physical activity, negative values indicated days of less than usual levels of happiness, depressed mood, anxiety, and physical activity, and positive values indicated days of more than usual levels of happiness, depressed mood, anxiety, and physical activity for each individual. The physical activity variable was slid forward by one day (as the question was phrased to measure previous day's physical activity) such that the within-person physical activity variable represented physical activity on a concurrent day to the reports of curiosity.

At level 1 (day-level variables) the formal model equation was constructed as:

$$Curiosity_{it} = \beta_{0i} + \beta_{1i}Day'sHappiness_{it} + \beta_{2i}Day'sDepressedMood_{it} + \beta_{3i}Day'sAnxiety_{it} + \beta_{4i}Day'sPhysicalActivity_{it} + \beta_{5i}DayoftheStudy_{it} + e_{it}\ , \quad (5)$$

where $Curiosity_{it}$ is curiosity for person *i* on day *t*; $\beta_{0i}$ indicates the expected curiosity on a typical day for the prototypical female (day of study was centered at 10.5 and female was the reference gender category); $\beta_{1i}$ indicates within-person differences in curiosity associated with differences in day's happiness; $\beta_{2i}$ indicates differences in curiosity associated with differences in day's depressed mood; $\beta_{3i}$ indicates differences in curiosity associated with differences in day's anxiety; $\beta_{4i}$ indicates differences in curiosity associated with differences in day's physical activity; $\beta_{5i}$ indicates the effect of day in the study on curiosity in order to account for time as a third variable (63). Finally, $e_{it}$ are day-specific residuals that were allowed to autocorrelate (AR1).

Person-specific intercepts and associations (from Level 1) were specified (at Level 2) as:

$$\beta_0 = \gamma_{00} + \gamma_{01}UsualHappiness_i + \gamma_{02}UsualDepressedMood_i + \gamma_{03}UsualAnxiety_i + \gamma_{04}UsualPhysicalActivity_i + \gamma_{05}Age_i + \gamma_{06}GenderMale_i + \gamma_{07}GenderOther_i + u_{0i}\ ,$$

$$\beta_1 = \gamma_{10} + u_{1i}\ ,$$

$$\beta_2 = \gamma_{20} + u_{2i}\ ,$$

…

$$\beta_5 = \gamma_{50}\ , \quad (6)$$

where $\gamma$ denotes a sample-level parameter and $u$ denotes residual between-person differences that may be correlated, but are uncorrelated with $e_{it}$. Parameters $\gamma_{01}$ to $\gamma_{06}$ indicate how between-person differences in the usual level of curiosity across the daily diary protocol were associated with usual levels of happiness, depressed mood, anxiety, physical activity, participant age, and participant gender. The multilevel model was fit with SAS 9.3 PROC MIXED (64) using maximum likelihood estimation, and incomplete data was treated using assumptions of being missing at random. Statistical significance was evaluated at $\alpha$=0.05.

**Mood as a mediator between physical activity and curiosity**

To examine whether physical activity's effects on curiosity were mediated via physical activity's effects on mood, we used a within-person (1-1-1) mediation model (65). As the focus was on within-person associations, all three variables were split into time-invariant and time-varying components (63). We calculated the time-invariant, between-person variables for *usual happiness*, *usual depressed mood*, *usual physical activity*, and *usual curiosity* as the grand-mean centered individual mean score of curiosity, happiness, depressed mood, and physical activity, respectively, across all days in the daily diary component of the study. We calculated time-varying, within-person curiosity, happiness, depressed mood, and physical activity variables as deviations from these between-person means. After splitting, the time-invariant components (between-person differences) were set aside and the time-varying components (day-to-day within-person changes) were examined using a multilevel mediation model.

The within-person mediation models are conceived of as two Level 1 regression equations: one where the mediator variable (using the model with happiness as an example), $M_{it} = Happiness_{it}$, is regressed on the causal variable, $X_{it} = PhysicalActivity_{it}$,

$$Happiness_{it} = 0 + a_i PhysicalActivity_{it} + e_{Mit}\,, \quad (7)$$

and one where the outcome variable, $Y_{it} = Curiosity_{it}$, is regressed on the mediator variable, $M_{it}$, and the causal variable, $X_{it}$,

$$Curiosity_{it} = 0 + b_i Happiness_{it} + c_i' PhysicalActivity_{it} + e_{Yit}\,, \quad (8)$$

where $a_i$, $b_i$, $c_i'$ are person-specific regression coefficients that indicate the unique within-person associations, and the zero is included to make explicit that between-person differences in baseline levels were set aside. The person-specific coefficients are modeled at Level 2 as

$$a_i = \gamma_{a0} + u_{ai}\,,$$
$$b_i = \gamma_{b0} + u_{bi}\,,$$
$$c_i' = \gamma_{c'0} + u_{c'i}\,, \quad (9)$$

where $\gamma_{a0}$, $\gamma_{b0}$, and $\gamma_{c0}$ indicate the prototypical within-person associations among the three variables, and $u_{ai}$, $u_{bi}$, $u_{c'i}$ are residual unexplained between-person differences in the extent of within-person associations that are assumed to be normally distributed with zero means and a full covariance structure, $\sim N(0, \Sigma_G)$.

In practice, equations 7 through 9 are combined and estimated simultaneously in a single multilevel model using data that are restructured so that the two outcome variables (mediator $M_{it}$ = $Happiness_{it}$ and outcome $Y_{it}$ = $Curioisty_{it}$) are collected into a single repeated-measures variable, $Z_{it}$, along with dummy indicators, $S_{mi}$ and $S_{yi}$, that indicate whether the specific

observation of $Z_{it}$ belongs to the mediator or outcome variable and that serve to "turn on" and "turn off" specific parameters for each row in the data (see 63, 65; 66). Using this setup, two separate mediation models (one with happiness as a mediator and another with depressed mood as a mediator) were estimated using SAS 9.3 PROC MIXED (64).

In multilevel mediation, the average indirect effect is given as

$$E(a_i b_i) = ab + \sigma_{ai,bi} \ , \tag{10}$$

where $a$ is the average effect of the causal variable (day's physical activity) on the mediator (day's happiness), $b$ is the average effect of the mediator variable (day's happiness) on the outcome variable (day's curiosity), and $\sigma_{ai,bi}$ is the covariance between the two random effects (67). The average total effect can be expressed as

$$E(a_i b_i + c_i') = ab + \sigma_{ai,bi} + c' \ , \tag{11}$$

where $c'$ is the unmediated portion of the physical activity to curiosity association for the typical participant. Estimates of the average indirect effect and average total effect were estimated using the IndTest macro (hppt://ww.quantpsy.org/medn.htm).

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The authors have no biomedical financial interests or conflicts of interest to disclose.

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Table 1

*Correlations and Descriptive Statistics*.

| **Variables** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Trait Curiosity** | - | | | | | | | | | | |
| **2. Curiosity Lability** | -0.28*** | - | | | | | | | | | |
| **3. CESD** | -0.08 | 0.17* | - | | | | | | | | |
| **4. Life Satisfaction** | 0.10 | -0.23** | -0.50*** | - | | | | | | | |
| **5. Flourishing** | 0.29*** | -0.18* | -0.54*** | 0.67*** | - | | | | | | |
| **6. Age** | 0.02 | -0.001 | 0.05 | -0.25** | -0.07 | - | | | | | |
| **7. Curiosity[a]** | 0.39*** | -0.73*** | -0.15* | 0.18* | 0.25** | 0.05 | - | | | | |
| **8. Happiness[a]** | 0.10 | -0.35*** | -0.35*** | 0.38*** | 0.39*** | -0.001 | 0.49*** | - | | | |
| **9. Depressed Mood[a]** | 0.03 | -0.03 | 0.59*** | -0.23** | -0.32*** | -0.03 | 0.02 | -0.29*** | - | | |
| **10. Anxiety[a]** | 0.05 | -0.06 | 0.51*** | -0.13 | -0.24** | -0.11 | 0.001 | -0.24** | 0.77*** | - | |
| **11. Physical Activity[a]** | 0.15 | -0.24** | 0.04 | 0.16* | 0.17* | 0.06 | 0.33*** | 0.14 | 0.08 | 0.08 | - |
| **Variables** | | | | | | | | | | | |
| ***Mean*** | 3.42 | 0.73 | 0.59 | 4.76 | 5.92 | 25.37 | 3.09 | 5.31 | 1.25 | 2.47 | 8.21 |
| ***Standard Deviation*** | 0.70 | 0.46 | 0.44 | 1.33 | 0.80 | 7.34 | 1.86 | 1.62 | 1.30 | 1.78 | 5.25 |

*Notes*: CESD = Center for Epidemiological Studies Depression Scale; [a]intraindividual mean of the daily diary time series; $N = 166$ for variables 1-6; $N = 167$ for variables 7-10.

Table 2

*Results of the multiple regression analyses examining associations between curiosity lability and depression, life satisfaction, and flourishing.*

| | | | |
|---|---|---|---|
| | | **Depression** | |
| | *Estimate* | *Standard Error* | *p*-value |
| **Intercept** | 0.57*** | 0.04 | <0.001 |
| **Trait Curiosity** | -0.02 | 0.05 | 0.73 |
| **Curiosity Lability** | 0.16* | 0.08 | 0.04 |
| **Age** | 0.004 | 0.005 | 0.33 |
| **Gender Male** | 0.07 | 0.09 | 0.42 |
| **Gender Other** | 0.82** | 0.30 | 0.008 |
| **Number of Days** | -0.02 | 0.01 | 0.17 |
| $R^2$ | 0.09 | | |
| ***F*** | 2.61* | | |
| | | **Flourishing** | |
| | *Estimate* | *Standard Error* | *p*-value |
| **Intercept** | 5.98*** | 0.07 | <0.001 |
| **Trait Curiosity** | 0.27** | 0.09 | 0.003 |
| **Curiosity Lability** | -0.26 | 0.14 | 0.06 |
| **Age** | -0.007 | 0.008 | 0.42 |
| **Gender Male** | -0.36* | 0.16 | 0.02 |
| **Gender Other** | -0.52 | 0.54 | 0.35 |
| **Number of Days** | -0.02 | 0.02 | 0.40 |
| $R^2$ | 0.14 | | |
| ***F*** | 4.20*** | | |
| | | **Life Satisfaction** | |
| | *Estimate* | *Standard Error* | *p*-value |
| **Intercept** | 4.82*** | 0.11 | <0.001 |
| **Trait Curiosity** | 0.04 | 0.15 | 0.81 |
| **Curiosity Lability** | -0.71** | 0.23 | 0.002 |
| **Age** | -0.04** | 0.01 | 0.001 |
| **Gender Male** | -0.41 | 0.26 | 0.12 |
| **Gender Other** | -0.55 | 0.90 | 0.54 |
| **Number of Days** | -0.02 | 0.04 | 0.58 |
| $R^2$ | 0.13 | | |
| ***F*** | 4.13*** | | |

*Notes*: All predictors were sample-mean centered. Gender was a factor variable with female as the reference category. ***$p$<0.001, **$p$<0.01, $p$<0.05. $N$ = 166.

Table 3

*Results of the multilevel model examining day-to-day associations with curiosity.*

| **FIXED EFFECTS** | | | |
|---|---|---|---|
| | *Estimate* | *Standard Error* | *p-value* |
| **INTERCEPT ($\gamma_{00}$)** | 3.30*** | 0.46 | <0.001 |
| **DAY'S HAPPINESS ($\gamma_{10}$)** | 0.34*** | 0.02 | <0.001 |
| **DAY'S DEPRESSED MOOD ($\gamma_{20}$)** | -0.10*** | 0.03 | 0.003 |
| **DAY'S ANXIETY ($\gamma_{30}$)** | 0.05 | 0.02 | 0.05 |
| **DAY'S PHYSICAL ACTIVITY ($\gamma_{40}$)** | 0.02*** | 0.01 | <0.001 |
| **DAY OF THE STUDY ($\gamma_{50}$)** | -0.002 | 0.01 | 0.80 |
| **USUAL HAPPINESS ($\gamma_{01}$)** | 0.53*** | 0.07 | <0.001 |
| **USUAL DEPRESSED MOOD ($\gamma_{02}$)** | 0.10 | 0.13 | 0.44 |
| **USUAL ANXIETY ($\gamma_{03}$)** | 0.09 | 0.09 | 0.36 |
| **USUAL PHYSICAL ACTIVITY ($\gamma_{04}$)** | 0.08*** | 0.02 | <0.001 |
| **AGE ($\gamma_{05}$)** | 0.03 | 0.02 | 0.08 |
| **GENDER MALE ($\gamma_{06}$)** | -0.21 | 0.48 | 0.66 |
| **GENDER OTHER ($\gamma_{07}$)** | -0.47 | 1.11 | 0.67 |
| **RANDOM EFFECTS** | | | |
| | *Estimate* | *Standard Error* | |
| **INTERCEPT ($\sigma^2_{u0}$)** | 2.11 | 0.26 | |
| **DAY'S HAPPINESS ($\sigma^2_{u1}$)** | 0.03 | 0.01 | |
| **DAY'S DEPRESSED MOOD ($\sigma^2_{u2}$)** | 0.01 | 0.01 | |
| **DAY'S ANXIETY ($\sigma^2_{u3}$)** | 0.001 | 0.001 | |
| **DAY'S PHYSICAL ACTIVITY ($\sigma^2_{u4}$)** | 0.01 | 0.01 | |
| **COVARIANCE ($r_{u0u1}$)** | 0.16 | 0.04 | |
| **COVARIANCE ($r_{u0u2}$)** | -0.05 | 0.05 | |
| **COVARIANCE ($r_{u0u3}$)** | 0.01 | 0.01 | |
| **COVARIANCE ($r_{u0u4}$)** | -0.03 | 0.04 | |
| **COVARIANCE ($r_{u1u2}$)** | 0.01 | 0.01 | |
| **COVARIANCE ($r_{u1u3}$)** | 0.0004 | 0.002 | |
| **COVARIANCE ($r_{u1u4}$)** | -0.001 | 0.01 | |
| **COVARIANCE ($r_{u2u3}$)** | -0.003 | 0.002 | |
| **COVARIANCE ($r_{u2u4}$)** | 0.001 | 0.01 | |
| **COVARIANCE ($r_{u3u4}$)** | 0.01 | 0.01 | |
| **AR(1)** | 0.25 | 0.02 | |
| **RESIDUAL ($\sigma^2_e$)** | 2.40 | 0.08 | |
| **FIT INDICES** | | | |
| **AIC** | 10551.30 | | |
| **BIC** | 10644.80 | | |

*Notes*: $N = 2737$ days nested within 167 participants. Age was sample-mean centered. Female was the reference category for gender.

Table 4

*Mediation model examining the within-person associations among physical activity, happiness, and curiosity.*

| **FIXED EFFECTS** | | | |
|---|---|---|---|
| | *Estimate* | *Standard Error* | *p-value* |
| **Physical activity → happiness ($\gamma_{a0}$)** | 0.04*** | 0.01 | <0.001 |
| **Happiness → curiosity ($\gamma_{b0}$)** | 0.35*** | 0.02 | <0.001 |
| **Physical activity → curiosity ($\gamma_{c'0}$)** | 0.03*** | 0.01 | <0.001 |
| **RANDOM EFFECTS** | | | |
| | *Estimate* | *Standard Error* | |
| **Physical activity → happiness ($\sigma^2_{u_{ai}}$)** | 0.002 | 0.001 | |
| **Happiness → curiosity ($\sigma^2_{u_{bi}}$)** | 0.04 | 0.01 | |
| **Physical activity → curiosity ($\sigma^2_{u_{c'i}}$)** | 0.001 | 0.001 | |
| **Covariance ($r_{uaub}$)** | -0.0004 | 0.002 | |
| **Covariance ($r_{uauc'}$)** | 0.001 | 0.001 | |
| **Covariance ($r_{ubuc'}$)** | 0.002 | 0.002 | |
| **Residual curiosity ($\sigma^2_{eY}$)** | 2.19 | 0.06 | |
| **Residual happiness ($\sigma^2_{eM}$)** | 3.01 | 0.08 | |
| **FIT INDICES** | | | |
| **AIC** | 20917.40 | | |
| **BIC** | 20941.40 | | |

*Notes*: $N$ = 2737 days nested within 167 participants.

Table 5

*Mediation model examining the within-person associations among physical activity, depressed mood, and curiosity.*

| **FIXED EFFECTS** | | | |
|---|---|---|---|
| | *Estimate* | *Standard Error* | *p-value* |
| **Physical activity → depressed mood ($\gamma_{a0}$)** | -0.01** | 0.005 | 0.003 |
| **Depressed mood → curiosity ($\gamma_{b0}$)** | -0.23*** | 0.03 | <0.001 |
| **Physical activity → curiosity ($\gamma_{c'0}$)** | 0.03*** | 0.01 | <0.001 |
| **RANDOM EFFECTS** | | | |
| | *Estimate* | *Standard Error* | |
| **Physical activity → depressed mood ($\sigma^2_{u_{ai}}$)** | 0.001 | 0.0003 | |
| **Depressed mood → curiosity ($\sigma^2_{u_{bi}}$)** | 0.05 | 0.02 | |
| **Physical activity → curiosity ($\sigma^2_{u_{c'i}}$)** | 0.002 | 0.001 | |
| **Covariance ($r_{uaub}$)** | 0.001 | 0.001 | |
| **Covariance ($r_{uauc'}$)** | 0.0001 | 0.0003 | |
| **Covariance ($r_{ubuc'}$)** | -0.003 | 0.003 | |
| **Residual curiosity ($\sigma^2_{eY}$)** | 2.48 | 0.07 | |
| **Residual depressed mood ($\sigma^2_{eM}$)** | 1.49 | 0.04 | |
| **FIT INDICES** | | | |
| **AIC** | 19292.50 | | |
| **BIC** | 19317.40 | | |

*Notes*: $N$ = 2737 days nested within 167 participants.

## Figure Captions

*Figure 1*. Partial residual plots illustrating the associations among trait curiosity (*top*) and curiosity lability (*bottom*) with depression, flourishing, and life satisfaction estimated from multiple regression analyses. The estimated associations are indicated in the top right corner of each panel. *Notes*: **$p$<0.01, *$p$<0.05.

*Figure 2.* Multilevel model results. Panel A depicts the prototypical within-person (blue line, $\gamma_{10}$=0.34, $p$<0.001) and person-specific (gray lines, $N$=167, $\beta_{1i}$=0.01 to 0.70) associations between day's happiness and day's curiosity. Lower than usual and higher than usual values of day's happiness on the x-axis correspond to -3 SD (-5.28) and +3 SD (5.28) on the day's happiness variable (where the minimum value in the same was -7.60 and the maximum value was 7.36) and the average value corresponds to 0. Panel B depicts the prototypical within-person (blue line, $\gamma_{20}$=-0.10, $p$=0.003) and person-specific (gray lines, $N$=167, $\beta_{1i}$=-0.37 to 0.09) associations between day's depressed mood and day's curiosity. Lower than usual and higher than usual values of day's depressed mood on the x-axis correspond to -3 SD (-3.72) and +3 SD (3.72) on the day's depressed mood variable (where the minimum value in the same was -4.51 and the maximum value was 7.89) and the average value corresponds to 0. Panel C depicts the prototypical within-person (blue line, $\gamma_{30}$=0.05, $p$=0.05) and person-specific (gray lines, $N$=167, $\beta_{1i}$=-0.11 to 0.19) associations between day's anxiety and day's curiosity. Lower than usual and higher than usual values of day's anxiety on the x-axis correspond to -3 SD (-4.89) and +3 SD (4.89) on the day's anxiety variable (where the minimum value in the same was -7.18 and the maximum value was 8.26) and the average value corresponds to 0. Panel D depicts the prototypical within-person (blue line, $\gamma_{40}$=0.02, $p$<0.001) and person-specific (gray lines, $N$=167,

$\beta_{1i}$=-0.02 to 0.07) associations between day's physical activity and day's curiosity. Lower than usual and higher than usual values of day's physical activity on the x-axis correspond to -3 SD (-17.40) and +3 SD (17.40) on the day's physical activity variable (where the minimum value in the same was -18.19 and the maximum value was 42.95) and the average value corresponds to 0.

*Figure 3.* Results of the within-person mediation models. Panel A indicates that days of higher than usual physical activity were associated with higher than usual happiness ($a$) and higher than usual curiosity ($c'$) and that days of higher than usual happiness were associated with days of higher than usual curiosity ($b$). The pie chart illustrates the portion of the effect of day's physical activity on curiosity accounted for by happiness. Panel B indicates that days of higher than usual physical activity were associated with lower than usual depressed mood ($a$) and lower than usual curiosity ($c'$) and that days of higher than usual depressed mood were associated with lower than usual curiosity ($b$). The pie chart illustrates the portion of the effect of day's physical activity on curiosity accounted for by depressed mood.

**Figure 1.**

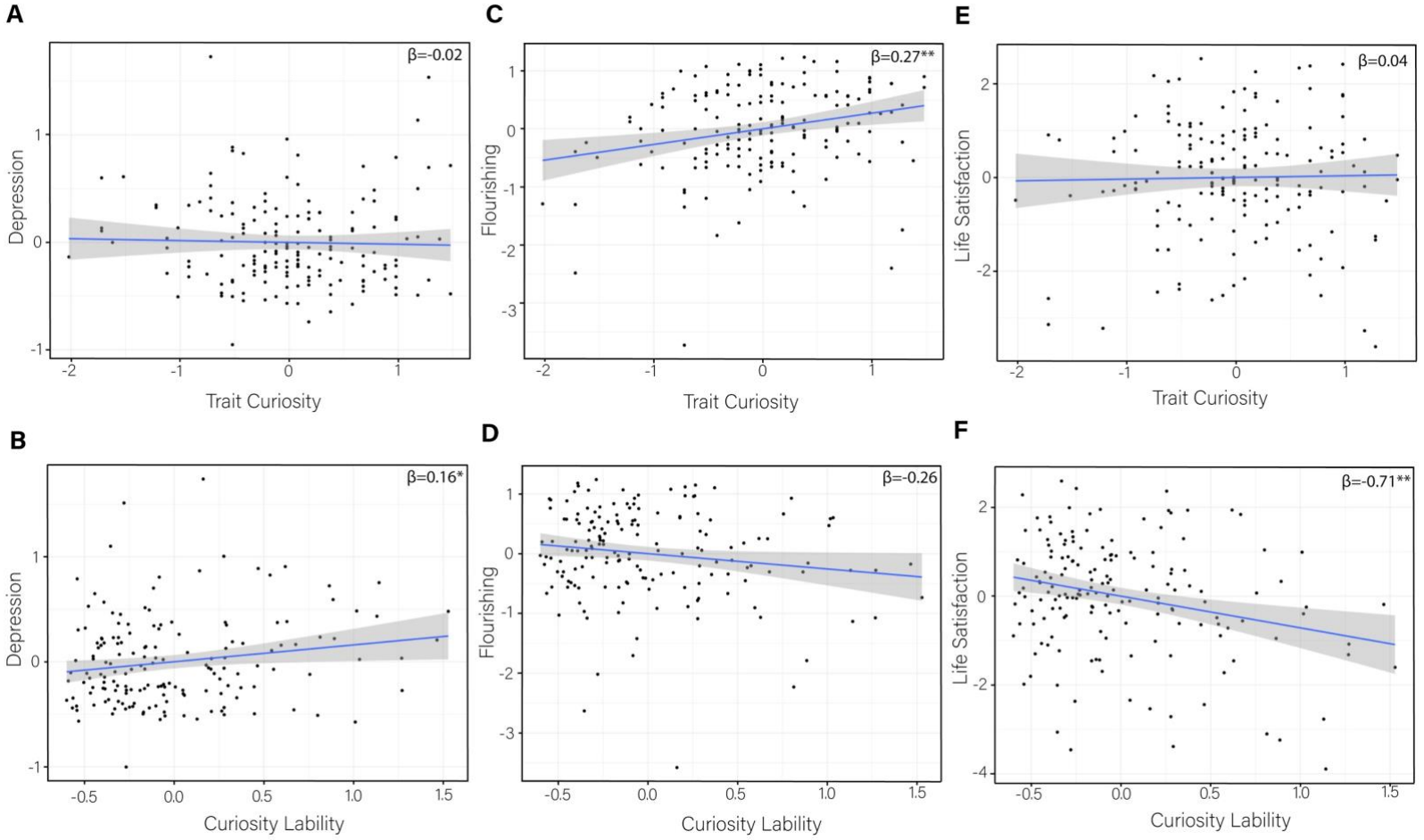

A
β=-0.02
Depression
Trait Curiosity
C
β=0.27**
Flourishing
Trait Curiosity
E
β=0.04
Life Satisfaction
Trait Curiosity
B
β=0.16*
Depression
Curiosity Lability
D
β=-0.26
Flourishing
Curiosity Lability
F
β=-0.71**
Life Satisfaction
Curiosity Lability

**Figure 2**

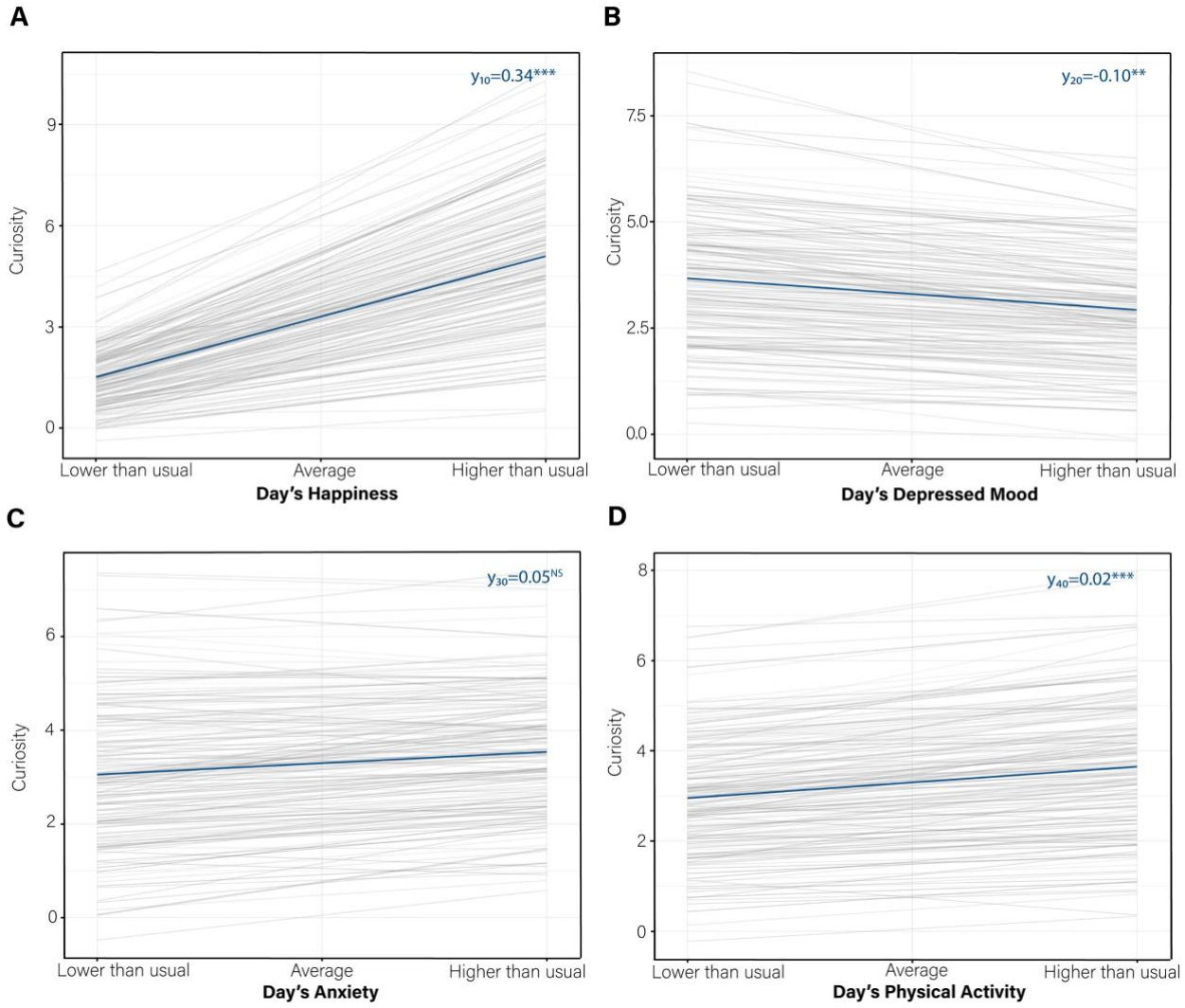
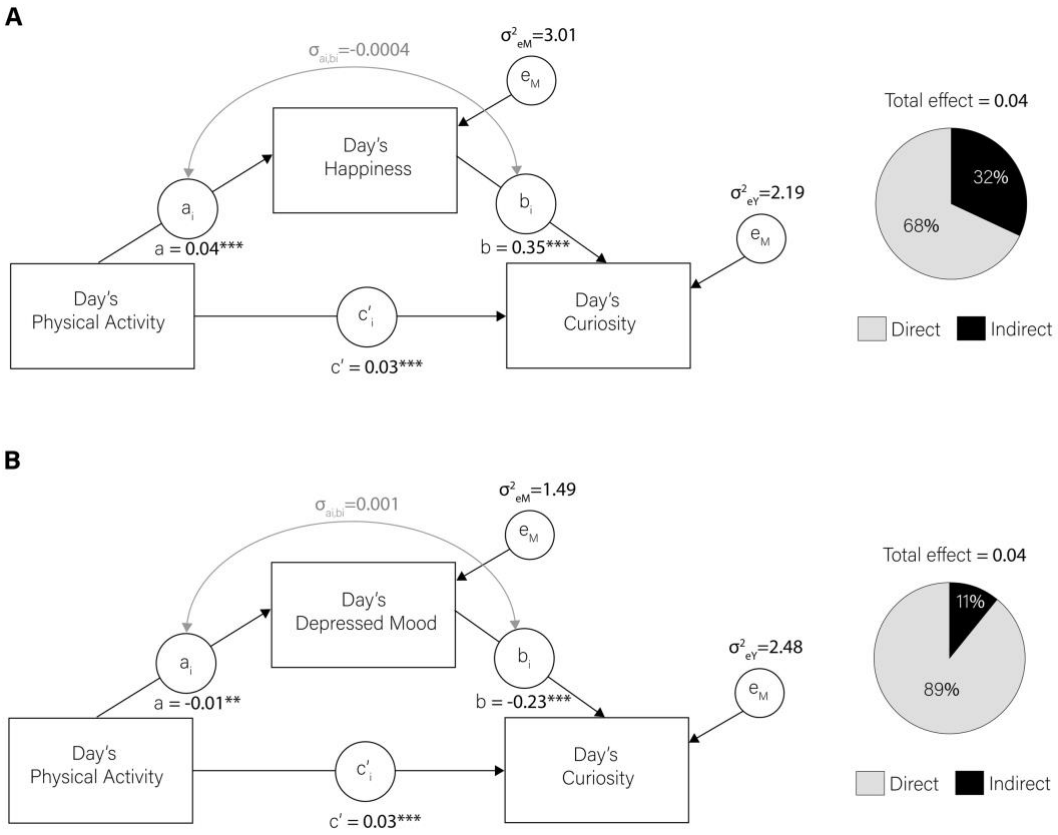

A
$y_{10}$=0.34***
Curiosity
9
6
3
0
Lower than usual
Average
Higher than usual
Day's Happiness
B
$y_{20}$=-0.10**
Curiosity
7.5
5.0
2.5
0.0
Lower than usual
Average
Higher than usual
Day's Depressed Mood
C
$y_{30}$=0.05$^{NS}$
Curiosity
6
4
2
0
Lower than usual
Average
Higher than usual
Day's Anxiety
D
$y_{40}$=0.02***
Curiosity
8
6
4
2
0
Lower than usual
Average
Higher than usual
Day's Physical Activity

**Figure 3**


A
σ²eM=3.01
σai,bi=-0.0004
eM
Day's Happiness
ai
bi
a = 0.04***
b = 0.35***
σ²eY=2.19
eM
Day's Physical Activity
c'i
Day's Curiosity
c' = 0.03***
Total effect = 0.04
32%
68%
Direct
Indirect
B
σ²eM=1.49
σai,bi=0.001
eM
Day's Depressed Mood
ai
bi
a = -0.01**
b = -0.23***
σ²eY=2.48
eM
Day's Physical Activity
c'i
Day's Curiosity
c' = 0.03***
Total effect = 0.04
11%
89%
Direct
Indirect