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Selflessness meets higher and more stable happiness: An experience sampling study of the joint dynamics of selflessness and happiness.

Nicolas Pellerin¹, Michael Dambrun², & Eric Raufaste¹

¹ Université Toulouse 2 (UT2J), CLLE, CNRS UMR 5263, Toulouse, France

² Université Clermont Auvergne (UCA), LAPSCO, CNRS UMR 6024, Clermont-Ferrand, France

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Author note

ORCIDs : Nicolas Pellerin (0000-0002-0223-1000), Eric Raufaste (0000-0003-0749-7964), Michael Dambrun (0000-0003-1418-7294)

Correspondence concerning this article should be addressed to Nicolas Pellerin, Toulouse.

E-mail: nicolas.pellerin@univ-tlse2.fr

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Abstract

Previous studies have demonstrated the existence of a positive relationship between selflessness and happiness. However, none of these studies yet contrasted the between- and within-person levels of analysis. Moreover, the Selflessness/Self-centeredness Happiness Model (SSHM) suggests that selflessness might stabilize happiness. In this experience sampling study, we explored the relationships between selflessness and happiness—baseline and stability—at both the within- and between-person levels. During five consecutive days, participants responded seven times a day to short questions about happiness and selflessness. Our results showed that more selfless individuals were happier, and that more selfless moments of an individual were happier moments. Moreover, more selfless individuals were more stable from one day to the other. Finally, when people became more selfless, their happiness gained stability for the next assessment moment and the next day. This study brings new evidence of the importance of selflessness for happiness.

Keywords: Selflessness; Happiness; Emotional Stability; Experience Sampling Method; Within and Between Person analyses

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1 Introduction

Emotional stability is an important factor of psychological health (Gruber et al., 2013) and well-being (Houben et al., 2015). However, while many studies have examined the consequences of emotional stability, few have investigated its causes. Based on the Selflessness/Self-centeredness Happiness Model (SSHM, Dambrun & Ricard, 2011) and an experience sampling methodology (Larson & Csikszentmihalyi, 1983) this study tests the contribution of selflessness to high and stable happiness.

The study of happiness has been intensified in the past decades (e.g., Linton et al., 2015). Researchers have developed a wide diversity of happiness models (Deci & Ryan, 2008; Huta & Waterman, 2014; Waterman, 1993). Within this variety, the most prominent approach to happiness is subjective well-being (Diener, 2018), which includes positive emotions, negative emotions, and “satisfaction with life”. Diener et al. (1985) construed satisfaction with life as an overarching construct beyond subjective well-being, which occurs as a judgment contrasting actual and expected life circumstances. As Kjell et al. (2016) proposed, “satisfaction only represents one important aspect of cognitive well-being involving the evaluative mindset based on self-centered expectations” (p.894, emphasis in the original). Although important, the judgmental mechanism may not be the only component for the experience of happiness. Indeed, a cross-cultural study showed that the most often expressed lay definitions of happiness are harmony and balance (29.13%), followed by satisfaction (16.55%), and positive emotions (13.92%) (Delle Fave et al., 2016). The role of harmony in the experience of happiness has been

emphasized in an emerging generation of models (Dambrun & Ricard, 2011; Kjell et al., 2016; Kjell & Diener, 2020). For example, Kjell et al. (2016) proposed complementing satisfaction with life with “harmony in life”, which emphasizes balance and flexibility.

Noteworthy, the Selflessness/Self-centeredness Happiness Model articulates these two views of happiness. The main hypothesis of the SSHM is that how one construes one’s self has an impact on the type of happiness experienced. A person experiencing the self as an independent and permanent entity (i.e., self-centeredness) will experience fluctuating happiness. Egocentric individuals rely primarily on stimulus-induced pleasures to be happy. However, not only do these pleasures depend on the presence of expected stimuli (Alba & Williams, 2013) but, even when the sought stimuli are accessible, hedonic adaptation prevents a sustained experience of pleasure (Armenta et al., 2014). When the desired stimulus is absent or when the undesirable ones are present, afflictive emotions such as anger or fear are generated (e.g., Bennett et al., 2020; Aue & Okon-Singer, 2015). The alternation of satisfaction and dissatisfaction phases that stems from self-centeredness leads to a low quality and fluctuating happiness (Dambrun et al., 2012; Dambrun, 2017).

A central hypothesis in the SSHM is that selflessness—construing the self as an interdependent and impermanent entity—induces the experience of harmony and reduces the amount of afflictive affect (manifesting in the form of emotional stability). Reducing egocentric focus would promote a sense of harmony by strengthening feelings of connection with others and the world and increasing unconditional benevolent affects (Dambrun & Ricard, 2012). Because in selfless individuals these two processes—harmony feelings and emotional stability—depend less on external stimuli, such persons will experience very stable low arousal feelings, named “Authentic-Durable Happiness” (Dambrun et al., 2012; Dambrun, 2017). In summary, the SSHM

predicts that selflessness would be associated with happiness in two ways: selflessness should (1) increase the individual level of happiness and (2) stabilize happiness variations within individuals.

Empirical studies mainly corroborated the main SSHM hypotheses. In self-report questionnaires studies, selflessness appeared positively associated with subjective and psychological well-being (Hanley et al., 2017, 2014). More specifically, selflessness has been associated with the authentic-durable happiness scale and negatively with the fluctuating happiness scale (Dambrun, 2017; Deng et al., 2020). The authentic-durable happiness (AD-H) scale has been developed by Dambrun et al. (2012) to be contrasted with fluctuating happiness, the two happiness measures being separate constructs. However, one could argue that their retrospective nature limits the two measures' validity by making them vulnerable to recollection biases (Kahneman, 1999). In particular, individuals would be unreliable in accounting for their past happiness fluctuations (see Kernis et al., 1992 for a related discussion on assessing the stability of self-esteem).

Experimental studies, using meditation induction, confirmed the relationship between happiness and selflessness at the experienced level (Dambrun, 2016; Dambrun et al., 2019). Accordingly, in an experience sampling study (ESM, Larson & Csikszentmihalyi, 1983), Pellerin et al. (2020) showed that selflessness and happiness were robustly associated and that enhanced feelings of harmony might explain their relationship. These studies used a more immediate assessment of experienced selflessness and happiness, so they do not suffer strong memory recollection bias. However, if they proved that selflessness increases happiness levels, their design did not allow for proper testing of the stabilization hypothesis. Multiple within-individuals measurements are necessary to correctly infer stability (Jahng et al., 2008).

In conclusion, if the existing literature supports a link between averaged happiness and selflessness, evidence for the effect of selflessness on happiness stability is still lacking. This study first aimed to test this “stabilization hypothesis” predicted by the SSHM, using multiple happiness measurements. For that purpose, we meant to run an ESM study with sufficient individuals and enough observations per individual for a correct estimation of happiness stability.

The second aim of this study was to evaluate the relationship between selflessness and happiness at both between-person and within-person levels (Hoffman & Stawski, 2009). Are people who are generally more selfless also happier than those who are more self-centered? This type of question is usually referred to as the *between-person level* of analysis (Hoffman & Stawski, 2009). ESM allows us to investigate the association between temporarily experienced selflessness and momentary happiness by focusing on their relationship at the *within-person level* of analysis (Hoffman & Stawski, 2009). At the within-person level, the question we address would be: Are momentary changes in selflessness in an individual associated with changes in happiness in the same direction? Although very helpful to confirm the causal role of selflessness, laboratory studies have limited ecological validity. Using the ESM would combine the advantages of avoiding retrospective memory biases and enabling selflessness and happiness assessment in individuals’ ecological contexts. Another benefit for our purpose is that the longitudinal design of the ESM allows the examination of the between-person and within-person relationships on the same data, thus clarifying each level’s weight in the prediction of the dependent variable (Enders & Tofighi, 2007; Hoffman & Stawski, 2009). Therefore, we meant to examine whether selflessness and happiness are associated at both within- and between-person levels. Based on the previously reported evidence, we hypothesized that:

- H1: high selfless individuals would be happier than low selfless individuals (between-person level).
- H2: change in selflessness within an individual would be positively associated with greater happiness (within-person level).

Moreover, we propose to explore the stability hypothesis at the different levels of analysis.

Most studies on emotional stability focus on inter-individual differences (Houben et al., 2015), but intra-individual processes but intra-individual processes are at least as interesting. For example, Hardy and Segerstrom (2017) showed how within-person emotional variability is associated with psychological distress and physical illness. The SSHM predicts that selfless individuals will experience better mean stability than self-centered individuals (i.e., inter-individual differences). We also wanted to test whether higher within-person selflessness would be associated with reduced happiness fluctuations in the short term (i.e., intra-individual process).

As Jahng et al. (2008) showed, there are several ways to consider stability in intensive longitudinal data, such as ESM studies, whether it is considered in the short or long term. In this study, we refer to short-term stability as the differences in happiness observed from one assessment to the next (i.e., within-day stability), and long-term stability as the difference in the average level of happiness from one day to the next (i.e., between-day stability). We expected that selflessness would positively influence both short-term and long-term stability. Therefore we expected to observe a positive association at the between-person level between selflessness and both long-term and short-term stability, meaning that not only selfless individuals will see their happiness to be more stable from one moment to another within the same day, but also from one day to another, in comparison with self-centered individuals. We also expected that changes of selflessness for the same person would be respectively associated with greater short-term and long-term stability, so that the happiness of the next moment would be more similar to the current happiness when current momentary selflessness is high and that the happiness of the next day

would be more similar to the mean happiness of the current day when the mean selflessness of the current day is high.

- H3 (between-person): happiness would be more stable within a day and between days in high selfless individuals than in low selfless ones.
- H3 (within-person): within-day and between-day changes in selflessness within an individual would stabilize happiness for the next moment and the next day.

2 Methods

2.1 Participants & Procedure

All respondents recruited through social networks during the second week of the first lockdown in France (the first week of May 2020). They were immediately invited to respond to an online survey that contained demographics and other variables non-related to this article ($N=1030$). ESM Volunteers could provide their cellphone number at the end of the questionnaire. It was clearly explained that this information would be used only for the purpose of running a one-week ESM study during the lockdown. The ESM study occurred during the second last week before “unlockdown.” Participants ($N=246$) were invited by SMS to respond to short online surveys seven times a day (mean time intervals = 1h30) from Monday to Friday and from 9 a.m. to 7:30 p.m. One hundred and two participants responded to at least one observation. To be able to account for happiness stability, we only retained individuals who provided at least five observations, leaving for the analysis 1687 observations (98% of all) over 347 days and 74 individuals (mean number of observations per day = 4.56, mean number of observations per participants = 22.8). Sixty-three participants were women (85.1%). The mean age was 42.8 years old ($SD=14.0$). After the end of the data collection, the personal well-being curves of participants were provided upon their demand.

2.2 Material

In each session, the participants had to answer several questions. Three items assessed selflessness (i.e., allo-inclusive identity, perceived body-boundaries salience, and oneness), and two items assessed happiness (i.e., satisfaction and inner peace) (for a similar measurement, see Pellerin et al., 2020). Other subjective dimensions not directly related to the present hypotheses were assessed and will not be presented here. Answers were registered using analog scales ranging from 0 to 100. The median time for completing a session was 121 seconds. To assess Cronbach alpha reliability estimates, we used the *alpha()* function provided in Huang (2017). It provides reliable estimates at the within-person level using the Multilevel Confirmatory Factor Analysis framework (Geldhof et al., 2014).

2.2.1 Happiness. Two items assessed happiness, one for satisfaction (i.e., “At this moment, I feel satisfied.”) and one for inner peace (“At this moment, I feel at peace”). The response scale ranged from “Not at all” (0) to “A lot” (100). The within-person reliability for happiness assessed by the two items was very satisfactory ($\alpha = .81$). All pairs of responses were averaged into a single measure of experienced happiness.

2.2.2 Selflessness. The same three items as in Pellerin et al. (2020) were used to assess experienced selflessness: (a) the first item was derived from the allo-inclusive identity scale, which assesses the degree of connection with others and the natural world (Leary et al., 2008). Perception of the interconnected nature of the self is an important marker of selflessness in the SSHM (Dambrun & Ricard, 2011). Four couples of circles were shown. In each couple, a circle labeled “you” crossed another circle labeled “others”, with the level of overlap indicating the degree of connection between the two entities. The participants rated their perception of

connection with others on a scale ranging from “no connection” (0) to “full connection” (100).

(b) The second item was the “perceived body boundaries salience” single-item scale. Dambrun (2016) derived this item from Ataria et al. (2015)’s work that the more flexible the sense of boundaries, the weaker the sense of self, ownership, and agency. The participants indicated their current perception of their body state using a visual analogue scale depicting their own body with boundaries varying from almost inconspicuous (0) to extremely salient (100). (c) The third item assessed oneness (“At this moment, I feel the unity with everything”). This item was derived from the oneness component of the mystical orientation scale (Francis & Loudon, 2000). The feeling of oneness is a marker for unified consciousness and has been discussed and used as an important component of selflessness in a previous study (Dambrun et al., 2019). The within-person reliability for selflessness assessed by the three items was moderately satisfactory ($\alpha = .59$). Note that although the reliability estimate might be lower than the traditional acceptable criteria for trait-level measures, Nezlek (2017) suggested relaxing the state-level reliability standards because ESM studies generally use fewer items per construct than classical surveys. The three items were averaged into a single measure of experienced selflessness.

2.3 Data analysis

We used R (R Core Team, 2020) for all our analyses. Five multilevel models served to test our hypotheses, with happiness scores (Model 1), the short-term instability (Model 2 and 3), and the long-term instability (Model 4 and 5) as dependent variables.

To predicts happiness levels (H1 & H2), model 1 was fitted using linear mixed models with the *lmer* function of the *lme4* package (Bates et al., 2015). The classical operation in multilevel analyses used to examine both between- and within-individual effects is to use the

cluster means and the individual scores centered within cluster as predictors in the model (Enders & Tofighi, 2007). Here, observations were nested within individuals. Therefore, individual selflessness means served as our cluster mean predictor, which we call “person-mean selflessness.” It was entered in all models to account for between-person effects. Averaging all observations within each individual eliminates any intra-individual variability. Therefore, estimates from person-mean selflessness should be interpreted as “pure between-person” relations between selflessness and the dependent variable. Then, for each individual, selflessness person-means were subtracted from their individual selflessness scores (i.e., “Centering within cluster”; Enders & Tofighi, 2007) in order to obtain measures of “within-person selflessness changes”, which were entered as a predictor in all models as an account for the within-person effect of selflessness. Centering within cluster is meant to clear any inter-individual differences in the variable. Thus only the intra-individual variability of selflessness is captured by this variable. Therefore, person-mean selflessness and within-person selflessness changes respectively capture inter- and intra-individual variability of selflessness and, together, capture the full variability of selflessness. Note that the selflessness score has been standardized before the computation of these two variables. Significant effects of person-mean selflessness on happiness scores in model 1 would indicate that inter-individual differences in selflessness influence person-mean levels of happiness accordingly (H1). Any effect of within-person selflessness changes on happiness indicates that temporary changes of selflessness below or above the individual’s average are associated with temporary changes in happiness (H2).

To compute the short-term and long-term stability of happiness (H3 & H4), we used the “squared successive differences” (SSD) and the “acute changes” (AC) using successive differences of the standardized score of happiness between two consecutive measurement

occasions and between two consecutive days, respectively (for details, see Jahng et al., 2008). The successive within-day differences have been adjusted for random time intervals using the method proposed in Jahng et al. (2008). SSD is obtained by squaring the successive difference. The other approach uses a cut point provided as a parameter by the researchers to define AC. We used two standard deviations as the cut point for acute changes so that 6.13% of the largest adjusted successive within-day differences were counted as AC and 6.02% of the successive between-day differences. Both measures were coded in the direction of instability in such a way that (1) a higher SSD value indicates a greater successive difference and (2) AC was coded 1 to indicate the presence of an acute change and 0 otherwise. In summary, four dependent variables accounted for happiness instability: the short-term SSD (ST-SSD; model 2), the short-term AC (ST-AC; model 3), the long-term SSD (LT-SSD; model 4), and the long-term AC (LT-AC; model 5).

To illustrate the instability variables, Figure 1 depicts the happiness levels during the ESM study with the AC and SSD for four individuals with different levels of happiness (in)stability. The mean squared successive difference (MSSD) and the probability of acute change (PAC) reflect individual means of instability. The first individual (see Figure 1a) had a very low short-term instability. Indeed we can see that this person presented only weak SSD's during the whole week (ST-MSSD = 0.12) and no acute change (ST-PAC = .00). Figure 1b displays these results for an individual with high short-term instability. We can see that the SSD's were stronger on much more occasions (ST-MSSD = 1.31). Acute changes were also numerous. This person had almost 1/3 chance to experience an acute change between two occasions (ST-PAC = .27). In the same way, Figure 1c depicts individuals with low long-term instability (LT-MSSD = 0.05; LT-PAC = .00 and Figure 1d and high long-term instability (LT-MSSD = 2.72 ; LT-PAC = .50).

INSERT FIGURE 1 NEAR HERE

Fig. 1 Scores, squared successive differences (SSD), and acute changes (AC) of happiness for individuals with low short-term instability (a), high short-term instability (b), low long-term instability (c), and high long-term instability (d)

Jahng et al. (2008) proposed to use generalized multilevel models to infer group differences in SSD and AC. It has the advantage of reducing the error of estimation of individual means and taking into account inter-individual differences in the number of observations. Additionally, the proposed models enabled to test for the specific within and between-person effects, as done with model 1. The distributions of squared successive differences (SSD) and acute changes (AC) theoretically do not follow normality. Consequently, ST-SSD (model 2) and LT-SSD (model 4) were modeled with gamma error distribution and log link and ST-AC (model 3) and LT-AC (model 5) with a binomial distribution as proposed by Jahng et al. (2008). Selflessness person-mean and within-person changes were entered as predictors. Note that, for models 2 and 3, one observation per participant was treated as missing because the last observation cannot be used to compute the short-term successive difference, which left 1653 observations in those models. A total of 347 aggregated days was available, leaving 273 observations for the long-term stability models (models 4 and 5).

3 Results

Descriptive statistics of the study variables can be found in supplemental material (Online Resource 1). Table 1 presents the results of the three multilevel models. Model 1 is the linear mixed model that regressed happiness scores on selflessness at both within and between levels. In

accordance with H1 & H2, we see that both person-mean selflessness and within-person selflessness changes were positively associated with happiness.

Table 1:

Results of the multilevel models.

	Predictor	<i>b</i>	SD	Lower CI	Upper CI	β
Model 1	Intercept	-0.05	0.06	-0.17	0.07	
DV = Happiness scores	Within-person selflessness changes	0.62***	0.02	0.57	0.67	.38
$N_{obs} = 1687$	Person-mean selflessness	0.60***	0.08	0.45	0.75	.47
Model 2	Intercept	- 0.62***	0.17	-0.96	-0.28	
DV = ST-SSD	Within-person selflessness changes	- 0.23***	0.06	-0.35	-0.11	-.14
$N_{obs} = 1613$	Person-mean selflessness	-0.13	0.22	-0.56	0.30	-.10
Model 3	Intercept	- 3.36***	0.25	-3.84	-2.88	
DV = ST-AC	Within-person selflessness changes	-0.39*	0.16	-0.70	-0.08	-.24
$N_{obs} = 1613$	Person-mean selflessness	-0.27	0.25	-0.76	0.21	-.21
Model 4	Intercept	- 1.60***	0.15	-1.90	-1.30	
DV = LT-SSD	Within-person selflessness changes	-0.41*	0.19	-0.78	-0.03	-.16

$N_{obs} = 273$	Person-mean selflessness	-0.40*	0.19	-0.77	-0.03	-.32
Model 5	Intercept	-7.59***	1.63	-10.78	-4.40	
DV = LT-AC	Within-person selflessness changes	-0.80	0.67	-2.11	0.51	-.30
$N_{obs} = 273$	Person-mean selflessness	-0.97	1.01	-2.96	1.01	-.78

Note. 74 individuals; ST = short-term, LT = long-term, SSD = squared successive difference, AC = acute change; b = unstandardized estimates, SD = standard deviation, CI = 95% confidence intervals; β = standardized estimates *** $p < .001$

The four remaining generalized multilevel models depict the results with ST-SSD (model 2), ST-AC (model 3), LT-SSD (model 4), and LT-AC (model 5) as dependent variables. Let's first consider the short-term stability, that is when stability is inferred from the difference between two measurement occasions within a day. Both measures of happiness short-term instability (ST-SSD and ST-AC) were negatively associated with within-person selflessness changes, meaning that positive deviations from the person's mean of selflessness diminish the subsequent differences of happiness and the chance to experience acute change. However, person-mean selflessness did not influence short-term instability.

Interestingly, these results differ with long-term stability. Long-term stability was positively associated with selflessness at both within- and between-person levels in model 4. This indicates two things: first, selfless individuals generally had fewer happiness fluctuations and, second, days with better mean scores of selflessness predicted fewer fluctuations of happiness the next day. However, long-term AC was not predicted by any level of selflessness.

4 Discussion

The first two hypotheses predicted that selflessness and happiness would be associated at both within-person and between-person levels. They have been verified. Thus, individuals with higher mean selflessness scores also had better happiness scores (H1), and within-person changes in selflessness were positively associated with momentary happiness (H2). This corroborates what previous studies found with different methods: not only the two variables are associated when treated as traits (Dambrun & Ricard, 2012; Deng et al., 2020; Hanley et al., 2017, 2014) but also state-like changes of selflessness appear to be associated with temporary increase of happiness (Dambrun, 2016; Dambrun et al., 2019). This indicates that selflessness improvements seem to be associated with better happiness levels. Finally, both effect sizes were moderate (see Table 1). All in all, these results strongly corroborate the general hypothesis of the SSHM, namely, that selflessness is substantially associated with better level of happiness (Dambrun & Ricard, 2011).

The last two hypotheses predicted that selflessness would be positively associated with short and long-term happiness stability at both within-person (H3) and between-person levels (H4). Short-term fluctuations were associated with selflessness only at the within-person level (H3), the between-person effect of selflessness on happiness short-term stability being not significant (H4). Selflessness significantly predicted long-term stability of happiness at both within- and between-person levels (H3 & H4) for one of the two indicators of stability used in this study (for SSD but not for AC). In summary, when people experience more selflessness than usual, they tend to see their current happiness as more similar to the next assessment period: happiness of the current moment and 1h30 after are more similar; happiness of the current day and the day after are more similar. However, highly selfless individuals appear to have better

long-term (between-days) happiness stability than more self-centered individuals. Still, no differences appeared for the short-term (within days) happiness stability.

These results add to a previous study showing a relationship between evaluated selflessness and fluctuating happiness measured (Dambrun, 2017). The main strength of the present study is that it operationalized the stability of happiness from individuals' actual experiences of happiness. Thus, it offers new evidence showing an association between selflessness and stability at the evaluated level (Dambrun, 2017). Furthermore, this method provided a first overview of the period during which the stability of happiness must be considered. Selfless individuals did not differ from others in happiness when stability was considered within a day, but they generally experienced fewer fluctuations from one day to the other. One would expect the same to be true when considering even longer periods, such as weeks or months. Future studies could extend the data collection period by using the Day Reconstruction Method, for example, to reduce the burden on participants. Finally, the SSHM assumptions about the fluctuations of happiness should be refined to allow precise predictions about how fluctuations happen in daily life, and specifically under which time frame.

Emotional stability is an important factor for psychological health (Gruber et al., 2013) and well-being (Houben et al., 2015). While the classic set-point theory of life satisfaction stability suggested that an individual's happiness is somehow stable and mainly determined by fixed personality (Parducci & Helson, 1965), recent data tend to refute this assumption in showing life satisfaction can lastly change (Headey & Muffels, 2017). Targeting a sustained reduction in self-centeredness—for example, through meditation practice (Dambrun, 2016; Dambrun et al., 2019))—could be an important way to stabilize happiness lastingly.

This study is not without limitations. the generalizability of the results is limited because the participants were mostly female. Moreover, the number of participants included in the ESM analyses was seventy-six, which can be low for individual differences research, even if the longitudinal design enhances statistical power. The high standard errors found with long-term acute change might suggest that statistical power is insufficient to detect the effect at the between-day level. Besides, all participants were confined and the importance of selflessness might have been enhanced by a situation where social interactions and activities are reduced to a minimum. On the other hand, the findings reported here will constitute interesting evidence to compare with when the study can be replicated under more “normal life” circumstances, with a larger sample including more male participants and with more days of observations.

5 Conclusion

Using an experience sampling study, we tested the hypothesis that selflessness is related to the baseline and stability of happiness at both the within- and between-person levels of analysis. Overall, more selfless individuals were more happy and more selfless moments for an individual were happier moments. Then, more selfless individuals were more stable from one day to the other, but this effect did not hold within a day. Importantly, regardless of the time period considered (within or between days), when people became more selfless, their happiness gained stability for the next moment. Not only this study confirms the importance of selflessness for the experience of high and stable happiness, but it demonstrates these effects in an ecological setting using the ESM methodology. Future researches will have to investigate the mechanisms by which selflessness improves happiness and reduces its fluctuations.

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Declarations

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Competing interests

The authors declare they have no financial interests.

Availability of data and material

The datasets analysed during the current study and the R scripts are available in the Open Science Framework repository, <https://osf.io/7csk9/>

Code availability

Not applicable.

Authors' contributions

NP, MD and ER designed the study. NP collected, analysed the results and wrote the first draft of manuscript. MD and ER revised the manuscript. All authors approved the final version of the manuscript.

Ethics approval

All procedures performed in these studies were reviewed and approved by Toulouse University's ethics committee (IRB00011835-2020-03-03-225). The study was conducted in accordance with the Declaration of Helsinki and its latest amendments.

Consent to participate

Informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.