

Matter app significantly improves life evaluation and positive affect in Matter game participants after six weeks

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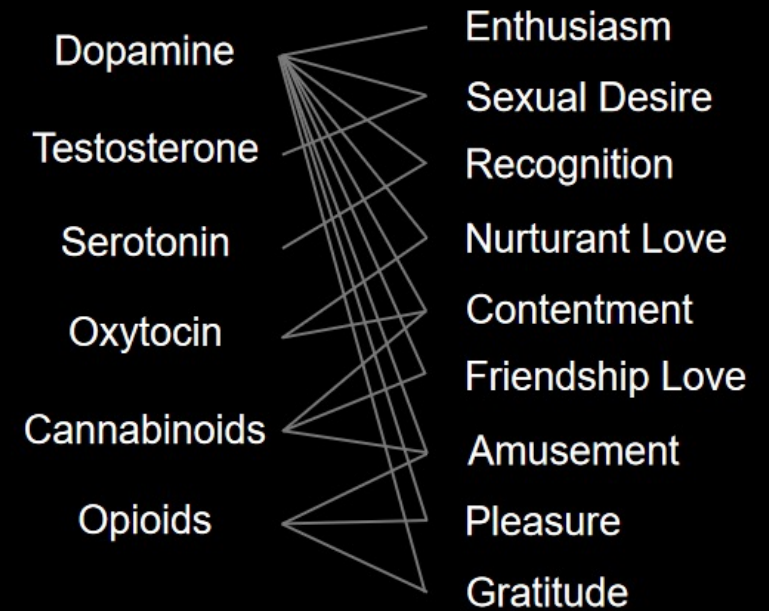
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Introduction

Subjective wellbeing (SWB) or happiness has been shown to have a profound impact on living a longer and healthier life [1,2]. One of the strongest predictors for high positive self-assessment of SWB is the experience of positive emotions. Theoretical frameworks have proposed a “family tree” of 9 positive emotions that are assumed to be selected during evolution in relation to six neurotransmitters underlying the human reward system [3] (A). However, while shown to correlate [4,5], a causal link between these emotions, neurotransmitters and increase in subjective wellbeing is poorly understood. Thus, we designed a real-life game supported by a digital app (Matter app) to guide game participants towards positive memory creation along those emotions while monitoring changes in SWB over time.

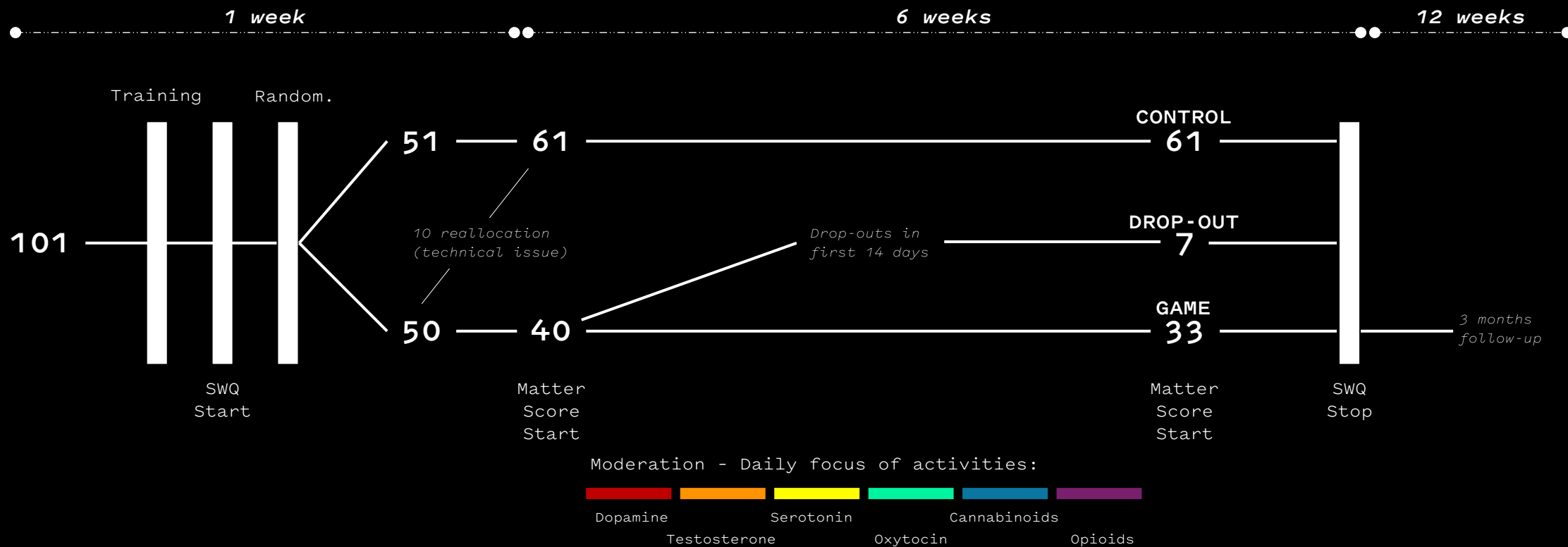
A) Target Emotions



Methods

101 healthy study participants (47 male, 54 female, age 23-45) were recruited to a real-life game with a digital flyer. Upon signing participant consent, participants received a 1h science introduction underlying the game and were afterwards randomized to a Control group (51; 24 male, 27 female) and Game group (50; 23 male, 27 female). 10 participants (4 male, 6 female) in the Game group were reallocated to the Control group from the Game group after randomization due to technical issues downloading the Matter app [6] essential for the game. Thus, control arm vs game arm was split 61 (28m/33f) to 40 (19m/21f) at the start of the game. The Game group used the Matter app[5] to collect images associated with individual positive memories and rate to which degree each of 9 positive emotions was present. Recorded memories were quantified using the Matter protocol underlying the Matter app. Recording and creation of good memories was guided by a central game coordinator who sent daily activities along the nine emotions and six neurotransmitters. Before the first day and after completion of six weeks, we administered the Subjective Wellbeing Questionnaire (SWQ) including questions about general life evaluation (e.g. “How satisfied are you with your standard of living?”) [7-12], affect (e.g. “How often have you felt positive during the past four weeks?”) [13], and flourishing (e.g. “Most days I get a sense of accomplishment from what I do.”) [14-17] to both Control group and the Matter group. Continued utilization of the app by the Game group participants was followed for 3 months after completion of the six-week study period (B).

B) Experimental Design



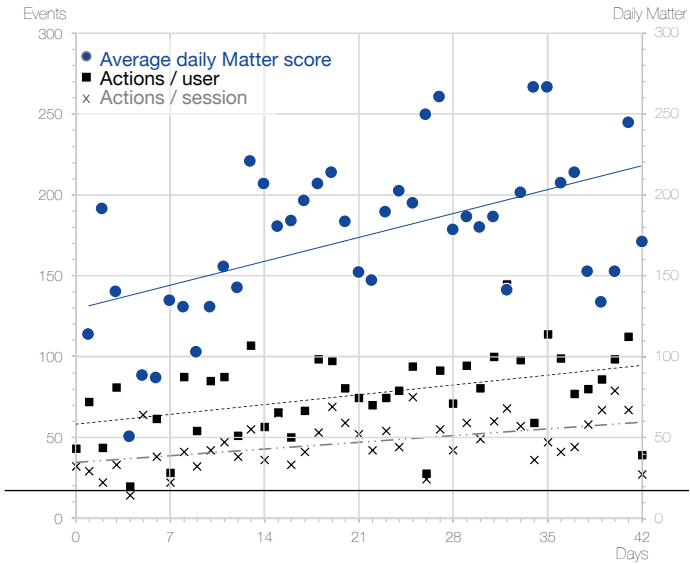
Results

33 of 40 Game group participants completed the 6-week game study. Over the game period the average daily Matter score increased by +69% which was partly associated with an increased use of the Matter app and more memories recorded. However, the Matter score increase outperformed the increase in app use suggesting that emotional intensity in the created memories increased over the game period.

Using the SWQ over the game period showed an increase in rating for Life evaluation by 45% vs 7% in the Game group and Control group, respectively. The Matter game had a highly significant benefit for Positive affect with the Game group doubling while the Control group staid flat. Flourishing trended positive for both groups with 44% in the Game group and 10% in the Control group.

After game completion, 17 participants decided to continue to use the app without any game moderator support. Three months later, 9 of 17 were still active (53%). Group sizes in the follow-up period were too small to obtain robust SWQ data.

6-week Matter game with subjective wellbeing assessment at start and after completion
(n = 101; 50 randomized, 40 started on Matter)



Average daily Matter score

Day 0		Day 42
129	<i>Matter</i>	218
129	<i>Control</i>	105*

Subjective wellbeing assessment

Life evaluation / Affect / Flourishing

Day 0		Day 42
84 / 24 / 62	<i>Matter</i>	122 / 49 / 89
88 / 22 / 64	<i>Control</i>	94 / 24 / 70

*Drop-outs were asked to complete one day of Matter rating after 42 days.

Conclusions

Our observational study demonstrated that participating in the Matter game using the Matter app increases life evaluation, positive affect in participants. Over the game period an increase of average daily Matter score could be observed driven by higher app utilization but also higher emotional intensity rating correlating with the data obtained from the SWQ. These data suggest the validity of the Matter protocol underlying the Matter score and confirms a positive link between positive emotions and subjective wellbeing in line with previous studies [5]. The study lays the foundation to use the Matter app as a tool to systematically study the link between distinct positive emotions, brain activation (7T fMRI) and neurotransmitter involvement (multi-tracer PET-MRI) in follow-up studies.

References: [1] Zaninotto, P., & Steptoe, A. (2019). Association between subjective well-being and living longer without disability or illness. *JAMA Network Open*, 2(7). [2] Xu, J., & Roberts, R. E. (2010). The power of positive emotions: It's a matter of life or death - Subjective well-being and longevity over 28 years in a general population. *Health Psychology*, 29(1), 9. [3] Shiota, M. N., Campos, B., Oveis, C., Hertenstein, M. J., Simon-Thomas, E., & Keltner, D. (2017). Beyond happiness: Building a science of discrete positive emotions. *American Psychologist*, 72(7), 617. [4] Walker, W. R., Skowronski, J. J., & Thompson, C. P. (2003). Life is pleasant—and memory helps to keep it that way!. *Review of general psychology*, 7(2), 203-210. [5] Alexander R., Aragón O.R., Bookwala J., Cherbuin N., Gatt J.M., Kahrilas I.J., Kästner N., Lawrence A., Lowe L., Morrison R.G., Mueller S.C., Nusslock R., Papadelis C., Polnaszek K.L., Richter S.H., Siltan R.L., Styliadis C., The neuroscience of positive emotions and affect: Implications for cultivating happiness and wellbeing, *Neuroscience & Biobehavioral Reviews*, Volume 121, 2021, Pages 220-249, [6] Matter - Science and Happiness (Version 1.0) [Mobile app] Apple TestFlight. [7] H Cantril (1961). *Human nature and political systems*; Published by Rutgers University Press, New Brunswick, NJ, 1961; [8] C Bjørnskov (2010). How Comparable are the Gallup World Poll Life Satisfaction Data? *Journal of Happiness Studies* 11 (1), 41-60; [9] E Diener, RA Emmons, RJ Larsen, S Griffin; *J Pers Assess.* (1985). Satisfaction with life scal; 49(1):71-5; [10] W Pavot, E Diener, CR Colvin, E Sandvik (1991). Further validation of the Satisfaction with Life Scale: evidence for the cross-method convergence of well-being measures; *J Pers Assess*; 57(1): 149-61; [11] RA Cummins, R Eckersley, J Pallant, J Van Vugt, R Misajon (2003). Developing a national index of subjective wellbeing: The Australian Unity Wellbeing Index. *Social Indicators Research*, 64, 159-190; [12] International Wellbeing Group (2013). *Personal Wellbeing Index (5th Ed.)*. Melbourne, Australia: Australian Centre on Quality of Life, Deakin University; [13] E Diener, D Wirtz, W Tov, C Kim-Prieto, D Choi, S Oishi, R Biswas-Diener (2009). New measures of well-being: Flourishing and positive and negative feelings; *Social Indicators Research*; 39: 247-266; [14] FA Huppert, TTC So (2013). Flourishing Across Europe: Application of a New Conceptual Framework for Defining Well-Being; *Social Indicators Research*; 110:837–861; [15] E Diener, D Wirtz, W Tov, C Kim-Prieto, D Choi, S Oishi, R Biswas-Diener (2010). New well-being measures: short scales to assess flourishing and positive and negative feelings. *Social Indicators Research*; 97(2): 143-156; [16] CLM Keyes (2002). *The Mental Health Continuum: From languishing to flourishing in life*. *Journal of Health and Social Behavior*; 43(2): 207-222; [17] ME Seligman (2011). *Flourish: A visionary new understanding of happiness and well-being (1st Free Press hardcover ed.)*. New York, NY: Free Press;

