Impacts of Behavioral Incentives on App Engagement in the Context of a Mental Health App

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NEUROFLOW®

Introduction:

- Mental health conditions are prevalent among college students and increasing in frequency and severity.[1] [2]
  - Exacerbated due to the COVID-19 pandemic.[3]
- Despite the availability of mental health services and treatment, relatively few people use these resources.[7]
- Many digital mental health smartphone applications have been created to facilitate aid for those who are unable to afford or access alternative mental health care methods.[4]
  - However, over 95% of mental health and wellness applications have not actually been studied.[5]
  - Majority of the available research examines user adoption instead of health outcomes.[6]
- Behavioral economics: Addressing the gap between those who need treatment and those who seek treatment
  - Incorporates findings from social and cognitive psychology and applies them to decision making.[8]
  - Two ways to apply behavioral economic principles to digital health are through gamification and Financial incentives.[9] [10] [11]

Methods:

- Participants:
  - Recruitment - via University of Pennsylvania's (UPenn) SONA Systems
  - Enrollment - participants are college students at the UPenn with access to a mobile phone who consented to download and use the NeuroFlow application
    - Participants were block randomized to one fo two groups: treatment (app with financial incentives) or control (no financial incentives)
- Materials:
  - Neuroflow = digital mental health application
- Outcome Measures:
  - Primary outcome - App engagement
  - Secondary outcomes - Depression symptoms (PHQ 8), Anxiety symptoms (GAD 7), Well-being (WHO 5), & Emotion regulation (DERS)
- Procedure:
  - Two-arm randomized controlled trial

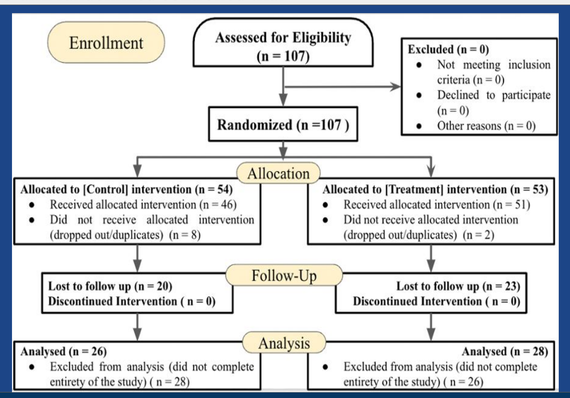

Table I. Particiapnt Characteristics

	Characteristics	Control M/N (SD/%)	Treatment M/N (SD/%)	Comparison Statistics
Age	*Years*	19.4 (1.1)	19.7 (1.8)	$t(81) = -0.913, p = 0.36$
Biological Sex	*Female*	29 (69.0%)	23 (53.5%)	$X2\ (1, N = 83) = 1.49,\ p = 0.22$
	Male	13 (31%)	18 (41.9%)	
	Missing	0	2 (4.7%)	
Race	*Asian*	15 (35.7%)	15 (34.9%)	$X2\ (4, N = 83) = 5.39,\ p = 0.25$
	White	19 (45.2%)	19 (44.2%)	
	Black or African American	4 (9.5%)	6 (14.0%)	
	Pacific Islander	0	1 (2.3%)	
	Other	4 (9.5%)	0	
	Missing	0	2 (4.7%)	
Hispanic/ Latino	*Non-Hispanic/Latino*	4 (9.5%)	2 (4.7%)	$X2\ (1, N = 83) = .67,\ p = 0.41$
	Hispanic/ Latino	38 (90.5%)	39 (90.7%)	
	Missing	0	2 (4.7%)	
Grade	*Freshman*	13 (31.0%)	9 (20.9%)	$X2\ (3, N = 83) = 4.52,\ p = 0.21$
	Sophmore	13 (31.0%)	21 (48.0%)	
	Junior	9 (21.4%)	4 (9.3%)	
	Senior	7 (16.7%)	7 (16.3%)	
	Missing	0	2 (4.7%)	
Income	**$10,000-$25,000**	2 (4.8%)	6 (14.0%)	$X2\ (3, N = 83) = 2.75,\ p = 0.43$
	$ 25,000-$-$45,000	5 (11.9%)	5 (11.6%)	
	$45,000-60,000	3 (7.1%)	4 (9.3%)	
	above $60,000	32 (76.2%)	26 (60.5%)	
	Missing	0	2 (4.7%)	

Goals:

- ***Understand how financial incentives encourage engagement with an online mental health platform, Neuroflow.***
  - Examine differences in users' anxiety symptoms, depressive symptoms, well-being, and emotion regulation before and after engagement with the NeuroFlow app.

Results:

Significance:
* = p < 0.05
** = p < 0.01

- No treatment group effect in any outcome
- No significant difference between completion rate percentage in the control and treatment
- Significant reductions in anxiety and emotion regulation difficulties across treatment groups
  - No differences on depression and wellbeing across treatment groups

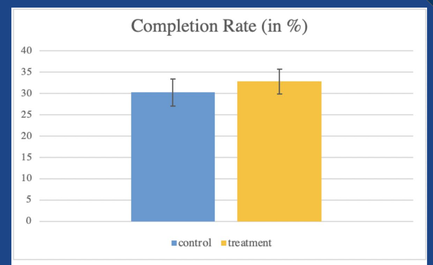

Figure 4: Completion rate in percentage of control and treatment groups. Error bars represent standard error.

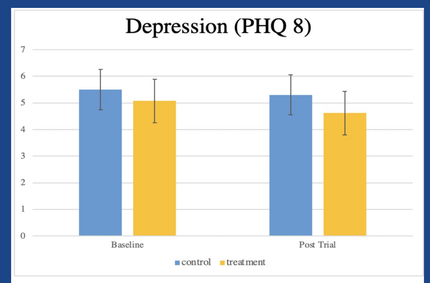

Figure 1: Baseline vs. Post Trial depression symptoms as measured by the PHQ 8 of control and treatment groups. Error bars represent standard error.

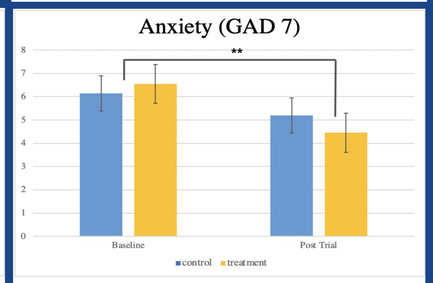

Figure 2: Baseline vs. Post Trial anxiety symptoms as measured by the GAD 7 of control and treatment groups. Error bars represent standard error.

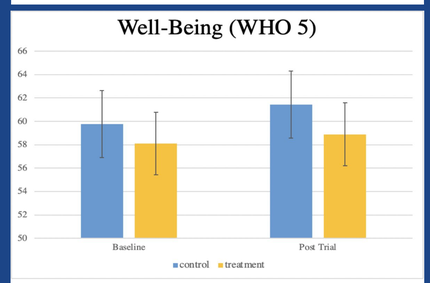

Figure 3: Baseline vs. Post Trial well-being as measured by the WHO 5 of control and treatment groups. Error bars represent standard error.

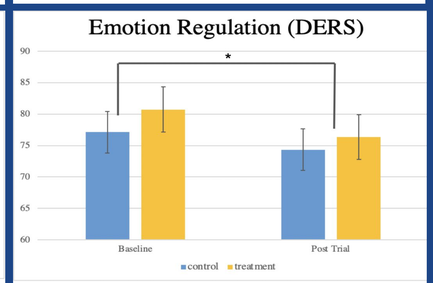

Figure 4: Baseline vs. Post Trial emotion regulation as measured by the DERS of control and treatment groups. Error bars represent standard error.

Conclusion:

- Financial Incentives do NOT significantly increase app engagement
- Financial Incentives do NOT significantly impact Anxiety, Depression, Emotion Regulation ability or Well-Being levels, relative to the Control (no financial incentives group)
- Use of Neuroflow led to reductions in Anxiety and Emotion Regulation but not in reductions in Depression and Well-Being

- **Clinical Implication:**
  - Digital mental health applications have the potential to reduce anxiety and emotion regulation difficulties over a relatively short period of time (1 month)

Discussion:

- **Limitations:**
  - Sample size/participant pool
    - Low Participant attrition rate
  - Primary incentive for study was SONA credit
  - Potential low salience of financial incentives ($10) for well-resourced student population
- **Future Research**
  - Increase financial inactive amount = increase salience
  - Longer study period (investigate prolonged impacts)
  - Diversify participant population

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References:

[1] Psychology, 36, 65–70. https://doi.org/10.1016/j.copsyc.2020.04.008 Hunt, J., & Eisenberg, D. (2010). Mental Health Problems and Help-Seeking Behavior Among College Students. Journal of Adolescent Health, 46(1), 3–10. https://doi.org/10.1016/j.jadohealth.2009.08.008
[2] Kitzrow, M. A. (2003). The Mental Health Needs of Today's College Students: Challenges and Recommendations. NASPA Journal, 41(1), 167–181. https://doi.org/10.2202/1949-6605.1310
[3] Copeland, W. E., McGinnis, E., Bai, Y., Adams, Z., Nardone, H., Devadanam, V., Rettew, J., & Hudziak, J. J. (2021). Impact of COVID-19 Pandemic on College Student Mental Health and Wellness. Journal of the American Academy of Child & Adolescent Psychiatry, 60(1), 134-141.e2. https://doi.org/10.1016/j.jaac.2020.08.466
[4] Huckvale, K., Nicholas, J., Torous, J., & Larsen, M. E. (2020). Smartphone apps for the treatment of mental health conditions: Status and considerations. Current Opinion in Psychology, 36, 65–70. https://doi.org/10.1016/j.copsyc.2020.04.008
[5] Lecomte, T., Potvin, S., Corbière, M., Guay, S., Samson, C., Cloutier, B., Francoeur, A., Pennou, A., & Khazaal, Y. (2020). Mobile Apps for Mental Health Issues: Meta-Review of Meta-Analyses. JMIR MHealth and UHealth, 8(5), e17458. https://doi.org/10.2196/17458
[6] Huang, H.-Y., & Bashir, M. (2017). Users' Adoption of Mental Health Apps: Examining the Impact of Information Cues. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5508115/
[7] Beidas, R., Volpp, K., Buttenheim, A., Marcus, S., Olfson, M., Pellecchia, M., Stewart, R., Williams, N., Becker-Haimes, E., Candon, M., Cidav, Z., Fishman, J., Lieberman, A., Zentgraf, K., & Mandell, D. (2018). Transforming mental health delivery through behavioral economics and implementation science: A project protocol (Preprint). JMIR Research Protocols, 8. https://doi.org/10.2196/12121
[8] Thaler, R. H. (2018). From Cashews to Nudges: The Evolution of Behavioral Economics. American Economic Review, 108(6), 1265–1287. https://doi.org/10.1257/aer.108.6.1265
[9] Cugelman, B. (2013). Gamification: What It Is and Why It Matters to Digital Health Behavior Change Developers. JMIR Serious Games, 1(1), e3139. https://doi.org/10.2196/games.3139
[10] Linnemayr, S., & Rice, T. (2016). Insights from Behavioral Economics to Design More Effective Incentives for Improving Chronic Health Behaviors, with an Application to Adherence to Antiretrovirals. Journal of Acquired Immune Deficiency Syndromes (1999), 72(2), e50–e52. https://doi.org/10.1097/QAI.0000000000000972
[11] Vlaev, I., King, D., Darzi, A., & Dolan, P. (2019). Changing health behaviors using financial incentives: A review from behavioral economics. BMC Public Health, 19(1), 1059. https://doi.org/10.1186/s12889-019-7407-8