

GAMIFICATION AND NUDGING TECHNIQUES FOR IMPROVING USER ENGAGEMENT IN MENTAL HEALTH AND WELL-BEING APPS

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ABSTRACT

In the last decades, mental health disorders have been a growing source of the global burden of disease. Thousands of mental health apps are available nowadays addressing this problem, but studies show that the effectiveness of these apps is jeopardized by the low user engagement.

This study investigates the most potentially effective gamification and nudging techniques in design for improving engagement in mental health apps for young people, by carrying out app-reviews for top installed mental health apps on Google play store and connecting it with engagement data, in addition to conducting expert-interviews with professionals from gamification and design background.

From the findings, techniques that participated in improving retention rates included using app character for creating app narrative and user interaction, in addition to adopting a non-forcible language. While to improve app daily duration of use, simplification nudge, and stating the recommended minutes of use found to be useful. Personalization and social interaction techniques were potentially effective for improving the frequency of app daily use. For the young age group, using juicy feedback and high-quality gamification were recommended

Keywords: Gamification, Nudge theory, Design for interfaces, Human behaviour in design, Design theory

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1 INTRODUCTION

Mental health disorders among young people (adolescents and young adults) have become a steadily growing source of the global burden of disease in the last decade (IHME 2019). In Sweden, since 1990 mental health disorders have been the largest burden of overall disability-adjusted life years (DALYs) among people aged between 10 and 24. The highest recorded rate was found in the latest dataset, with mental health disorders having approximately 25% of overall DALYs in Sweden (IHME 2019). To address the problem of mental health disorders, different eHealth/mHealth platforms and services are being developed and show great potential for improving mental health and well-being (Chandrashekar 2018; Wang et al. 2018; Hwang and Jo 2019). Several studies show that engaging with mental health apps could reduce symptoms of depression and anxiety, and increase mental well-being (Bakker and Rickard 2018).

For a mental health app to be effective users need to have a dynamic sustainable engagement with the app, that allows users to start and continue using it. Glenn et al. (2013) found that patient engagement was a stable and robust predictor for the reduction of mental health symptoms including anxiety and depression in cognitive-behavioural therapy (CBT) sessions. Additionally, for example in meditation interventions a duration of 10 minutes of daily practice in a course of 16 weeks was found to have significant positive impact on brain processes (Moore et al. 2012). This illustrates the importance of daily activation and user engagement to achieve the best outcomes from using mental health apps, as behavioural interventions require a process of steps that needs commitment and relatively long-term engagement to have the desired outcome (Sharma and Andrade 2012).

Unfortunately, the engagement levels in thousands of mental health apps available on different app stores nowadays is relatively low. Several studies have shown that these apps lose most of their users within the first two weeks after installation (Baumel et al. 2019; Bauer et al. 2020). To deal with this problem and thus develop more efficient mental health apps, Chandrashekar (2018) recommends using gamified interactions to improve engagement. Cheng et al. (2019) showed that one of the main reasons for using gamification in mental health apps design was promoting user engagement, however, Cheng (2019) and other studies did not provide practical knowledge on how to design for this objective.

Another commonly used technique for influencing user behaviour is the use of nudge theory or behavioural economics to create indirect reinforcement (Thaler and Sunstein 2009). To the best of our knowledge no previous studies exist that connect the application of nudge theory in app design for improving engagement in mental health apps. Nevertheless, behavioural economics was recommended as a cost-effective method to promote public health by Sunstein et al (2014). In addition, there are several studies showing the potential use of nudging for achieving effectiveness and improving engagement in different public health interventions (Arno and Thomas 2016; Matjasko et al. 2016).

Both gamification and nudging seem to be promising techniques for improving user engagement within mental health apps. This paper presents a study about these two design approaches with the aim of investigating the most suitable gamification and nudging techniques to improve user engagement in mental health apps for young people.

To reach the study aims, the following questions will be investigated:

- (1) What are the most potential gamification and nudging design techniques in mental health apps that could be used to improve onboarding engagement (i.e.: retention in the first 1-2 weeks after installing the app), user retention (continuous use of the app on the long term after the onboarding), daily duration (time of use per day), and frequency of use (number of sessions per day)?
- (2) How to tailor the design of these techniques to be suitable for young people (adolescents and young adults)?

The study focuses on the self-management mental health apps that were designed to promote mental well-being using different behavioural change methods such as mindfulness, cognitive-behavioural therapy (CBT), meditation, and other techniques used in these apps that does not require a therapist or direct human assistance.

1.1 Background

Gamification has been defined by Zichermann and Cunningham (2011) as “The process of game-thinking and game mechanics to engage users and solve problems”. Several gamification frameworks have been developed to demonstrate how to design for gamification. One framework that includes both users and designers is the Mechanics-Dynamics-Aesthetics framework (MDA) in which we use in this

study ([Hunicke et al. 2004](#)) it dissects the design of gamification into three main components: Mechanics, Dynamics, and Aesthetics. Mechanics are the gamified elements that users can see and interact with on the app screen (e.g.: points, badges, and leaderboards), dynamics are the functions connecting between mechanics and aesthetics (e.g., rewards, providing feedback, and interactivity), and aesthetics are the emotional effects that these elements evoke in the users (e.g., feeling of curiosity, motivation, fun, connected).

Nudge theory is based on behavioural economics which combines the rational nature of human behaviour from economics theory perspective, and the human cognitive biases from the psychological one which participate in influencing personal decision making ([Thaler and Sunstein 2009](#)). A nudge could be defined as an indirect positive reinforcement toward specific planned behaviour based on a choice architecture with a predictable effect, using human features like cognitive biases, heuristics, non-rational, and non-conscious features ([Thaler and Sunstein 2009](#); [Hagman 2018](#)). Main ethical and effectiveness considerations when designing a specific nudge is to make sure that it maintains the freedom of user choice (non-forcible), to be transparent without hidden objectives, and to be relying on evidence-based methods rather than intuitions or non-scientific basis ([Sunstein 2014](#)).

2 MATERIALS AND METHODS

2.1 Overview

This study followed a two-step process, firstly by carrying out app-reviews for top installed mental health apps on Google play store, and secondly conducting expert-interviews with professionals in gamification and design.

2.2 Sampling

In the app-review step, the top installed mental health apps on Google play store were identified, with inclusion criteria set in line with the study objectives. Inclusion criteria included for the apps: to be available on Google play store in English, the last app update to be within the last 12 months prior to the data collection process, and the app designed to deal with one or more of mental health and well-being domains. Apps based only on communication with psychiatric or music-based apps were excluded. Eight searches on Google play were executed using the following keywords: “Mental health”, “Well-being”, “Stress”, “Anxiety”, “Depression”, “Mindfulness”, “Sleep”, and “Relaxation”. A data scraper instrument was used to extract data from the search results on Google play including: the name of the apps; number of installs; and the date of the last update. The total number of original apps found was 1322 of which 942 were retained after applying the exclusion criteria and filtering out any duplicates.

For expert-interviews, the inclusion criteria for eligibility was to have previous experience in gamification in relation to health apps projects within one or more of the following fields: game design, web design, user experience design (UX), research, mental health app development, or eHealth. Ten interviews were scheduled to be conducted remotely (due to the COVID-19 pandemic and social distancing recommendations).

2.3 Data collection

Engagement data were collected for the identified apps from SimilarWeb platform for the three consecutive months (January, February, and March 2020), the following quantitative data was collected: average daily duration of use; the average number of sessions per day; the retention rate for users that continued using the app after installing it, for the days from 1st to 7th and the 30th day. The quantitative engagement data were collected for the top 50 apps, to have large enough sample size for the estimation of the average engagement in these apps, and to compare it with the reviewed apps in the first step. In the app-review step, apps were reviewed qualitatively from the most popular ones on Google play until reaching study saturation level, in which 14 apps were reviewed.

Two types of data were collected during the reviewing process. Firstly, quantitative data using a list of 26 techniques specifically developed for this study. The list contained the 13 most commonly used gamification mechanics derived from the gamification literature related to mental health and from Werbach’s gamification toolkit ([Werbach and Hunter 2015](#); [Hoffmann et al. 2017](#); [Cheng et al. 2019](#)),

and 13 nudges (Thaler and Sunstein 2009; Sunstein 2014; Stawarz et al. 2015) The list can be seen in Table 1.

Secondly, qualitative data were collected using a template developed which consisted of eight main categories of questions regarding the use of gamification and nudging techniques in different phases of the app design process: 1) first onboarding design notes; 2) techniques used in the “home page”; 3) techniques used in the “activity page”; 4) customization/personalization design elements; 5) social interaction elements; 6) self-monitoring design and methods; 7) general gamification strategies; 8) most significant nudges. This template was developed based on a previous phase of reviewing available literature.

In the next step, the expert-interviews were conducted using a semi-structured interview guide with open-ended questions, developed during the app-reviews phase. The guide consisted of different themes regarding how to use gamification and nudging for improving engagement in mental health apps, themes included: onboarding engagement (after installing the app); daily visits before habit formation; retention and long-term habit formation; duration of visits; customization/personalization; engagement barriers; and age criteria. The duration of each interview was between 45 and 60 minutes.

Ethical considerations regarding data collection, SimilarWeb and Google play store platforms does not provide any personal data of users which complies with data privacy regulations, and in the expert-interviews, all interviews were held remotely with written consent sent via email before the interview and a verbal one at the start of each interview regarding the voluntary nature and anonymity of participation.

2.4 Data analysis

Quantitative engagement measurements collected from SimilarWeb and the reviewed apps were analysed using SPSS and Excel software (Software for quantitative data analysis) in which it was mainly used to identify medians, interquartile ranges (IQRs), and to generate visualization output. While qualitative data in the app-reviews and expert-interviews were analysed using Nvivo 12 (Qualitative data analysis software) after transcribing and organizing the data in word documents for each app/participant, in which interviewees were numbered (Expert 1, Expert 2, Expert 3 ..etc.) for reference in the results section.

During the analysis of expert-interviews, different themes were coded for each type of questions according to the semi-structured questionnaire guide, then nodes for each theme were coded after a second reading by determining the factors that affect or answer each question. Finally, a pattern of factors was identified based on the repetition of codes, answer type (generic, user-centric, and practical), and the significance of the answer based on the background of each participant concerning the question.

Reporting results of most potentially used gamification and nudging techniques were based on the similarities found in the different methods used in this study (quantitative engagement data, qualitative app-reviews, and expert-interviews) or i.e.: The reoccurrence of the same finding in more than one method (Engagement data, app-reviews, or expert interviews) for gamification and nudging techniques, indicated a higher significance to be reported in the results.

3 RESULTS

3.1 Overview

In the top installed mental health apps, data analysis of user engagement data from SimilarWeb platform show that the median of user-retention for the days 1,3 and 7 were respectively 50% (IQR 34%), 14.5% (IQR 21.25%), and 7% (IQR 10.5%). The median number of sessions spent per day for users was 2.7 (IQR 0.89), the average duration of daily use of apps was approximately equal to 7 minutes (IQR 09:35). For the reviewed apps, the average number of gamification and nudging techniques used in a single app was approximately 4 gamification mechanics and 7 nudges per app from the 26 pre-defined techniques (13 gamification mechanics and 13 nudges), as shown in Table 1 and Figure 1.

Table 1. Number of times (No.) gamification mechanics and nudging techniques were found in the 14 reviewed apps

Gamification mechanics	No.	Nudging techniques	No.
1. Progress levels: Guided levels of progression in the app's content.	10	1. Self-monitoring: Tracking mental health-related variables (e.g.: Mood tracking)	13
2. Unlocking: Unlocking rewards, achievements, content ..etc. with progress.	9	2. Reminders: e.g.: Mobile notifications.	13
3. Badges/Stickers: as rewards after achieving specific goals.	7	3. Increases in ease and convenience: e.g.: easy to understand design or navigation bar.	12
4. Collections: e.g.: set of pre-defined badges for users to collect over time.	6	4. Simplification in navigation and design (i.e. transforming complex concepts into more simple process).	10
5. Avatars: personal user avatar.	4	5. Chunking: Separating content or instructions into pieces.	10
6. Chatbot: using conversational agents in the app.	4	6. Eliciting implementation intentions: referring to the reason of the visit (e.g., "Do you want to track your mood today?")	9
7. Points: i.e., experience points (XP).	3	7. Precommitment strategies: e.g., allowing users to commit to a defined course of activities in a specific amount of time.	8
8. Rank: personal level for users representing their progress.	3	8. Default rules: e.g., having a default non-forcible recommended option for engagement with a specific part of the app.	7
9. Social graphs: showing and data analytics of other users in graphs.	2	9. Social norms: e.g., showing what most/many users chose or done.	6
10. Leaderboards: tables showing the user's results, allowing them to compare it with others.	1	10. Loss aversion: nudging engagement by avoiding the risk of loss (e.g.: avoiding losing streak badge of continuous app use)	6
11. Quests: having a specific mission with specific challenges, and being rewarded at the end after quest completion.	1	11. Disclosure: e.g., mentioning the people behind the app and how data were used.	3
12. Teams: cooperation with other users.	1	12. Informing people of the consequences of their own past choices	1
13. Gifting: sending gifts for other users.	1	13. Warnings, graphic or otherwise	0

Regarding the relationship between engagement and design techniques frequency, the increase in the number of gamification mechanics and nudging techniques in a specific app was not associated with a corresponding increase in engagement values, as it can be seen in Figure 1 below.



Figure 1. Engagement, gamification, and nudging techniques insights for the 14 reviewed mental health apps

“HeadSpace” app had the most stable and highest rates of user retention in the first week till the end of the first month of use, with 29%, 28%, and 20% of user retention for the 3rd, 7th and 30th days of use respectively. The daily duration of use was higher in apps that used social interaction such as Chatbots or social communities which was found in “Replika”, “Friend shoulder”, “7 Cups”, “Wysa” and “Youper” as all of these apps had a significantly higher duration of use than the average (7 minutes in other reviewed apps). The only app with a high duration of use without social interaction was “Calm” with 20

minutes of average daily use. “Replika” app had the highest average number of sessions per day with 5.96 which is more than twice the average frequency in the reviewed apps (2.7 sessions per day).

3.2 Onboarding and User retention

From the engagement data and app-reviews, “HeadSpace” had the highest retention rates in the first 7 days of use. Special features and techniques observed in this app were: 1) A unique onboarding phase compared with other reviewed apps in which the “Default rule” nudge were used to direct the user to start the first meditation session (as a default choice with a skipping button) before reaching the main app interface, also the onboarding consisted of 7 steps which resemble a “Simplification” nudge to simplify the start of using the app (e.g.: providing three informative sentences to introduce the app for the user to reduce possible complexity in understanding the app). 2) Gamification techniques that were observed included: a) using different avatars for drawing a story for the app, b) using a “Progress bar” for providing feedback of progress in meditation sessions, c) using user “Avatar” images for personalization. Regarding user retention in expert-interviews, “App character” (a technique which refers to using a specific app character such as 2d/3d interactive models or avatars to create narrative or playfulness experience) was described as a successful technique by three interviewees, including Expert 9 which mentioned from their experience it motivated long-term engagement especially for having a playfulness core loop interaction between the user and the character: *“we have this project with different plant seeds in the ground.. we were surprised to see it is still there and they log in nearly every day to play.. you plant the seed, then you come back to that place, you water it, you make it grow. That's the core loop in that game.. they've been using it for one and a half years now..”*

As a nudging technique, Expert 10 mentioned that retention was improved significantly when they used a non-forcible nudging language: *“When we encouraged the person to think about why they would not want to engage with the chatbot over time, it doubles the number of people that engaged with chatbot.. from a clinical standpoint it is that if you force somebody into something, and humans are very good at detecting this, and will start to resist straightaway”*.

3.3 Daily duration of use

As reported in the overview, the app “Calm” was the only app without social components and relatively high in daily usage, related to this the following techniques and features were observed in this app: 1) The simple design of user interface (UI) compared with other reviewed apps (i.e: Simplification nudge), 2) short meditation sessions 10 to 15 minutes maximum (i.e: Chunking nudge), 3) the name of the app “Calm” could be considered as an “Eliciting implementation intentions” nudge, in which as the name states the intention for using the app is to relax, 4) Using a calming softly animated light blue background and nature background music in the app interface and content, which also was referred by Expert 2 in the expert-interviews, that pointed out the importance of building a feeling of quality and the creation of a relaxing atmosphere induced by the design elements: *“one thing that we underestimate is the quality of the content, I'm talking about the voice that are leading you, the music in the background, the graphics and so on, there is one app that is highly successful I think it's called Calm, It's sort of rather nice, simple animation with a nice aesthetics to it.”*. 5) Gamification mechanics in “Calm” were only observed as badges for the streak of use (e.g: when you come back to use the app for three consecutive days you get a badge) and changing the theme of the app interface (personalized by the UI design).

In the expert-interviews, there were also suggestions of how to reach a specific daily app interaction duration. Expert 1 suggested to use a direct nudge to the targeted daily duration, by informing the users of the possible positive effect of having the specified time and rewarding them for reaching it: *“I think it's valuable to be explicit to the user as say that we encourage you to do this for this certain time period because that will lead to better mental health or..whatever, and then show them that they will be rewarded for this behaviour and one way (to achieve) that is of course through points and levels, etc.”*.

3.4 Number of sessions per day

In the app-reviews, two apps: “Replika” and “Stop, Breathe & Think”, had a significantly higher number of sessions for daily use, with around twice the average. A common special feature observed in the design of both apps was the fast reach of user needs, in which a direct connection between user needs and app output were achieved using personalization elements, in which in “Stop, Breathe & Think” for

each session a short assessment of user needs comes first then followed by app suggestions, while in “Replika” a response to a specific need is directly met, which was also mentioned in expert-interviews by Expert 2 that recommended to provide fast reach to user needs as a generic perspective of providing effective user engagement: *“It's way better to have a multiple choice in the beginning that goes really, really fast. How are you feeling today?.. Do you feel that on this level?.. I said, we suggest that you do this activity. Do you think that's correct?.. That's a better way of taking the use of apps and not wasting their time.”*

“Replika” was not the most app that used gamification techniques in quantity, but it was the most one that noticeably used it in density (i.e: having gamification in most parts of the app). Gamification techniques in “Replika” included: using points of experience (XP) in the main page, selecting the Chatbot’s name and setting up a 3D avatar for both user and Chatbot with facial textures (Personalization options in design), and adopting a playful social narrative by having a 3D app environment. While “Replika” used gamification techniques mainly in the main activity page other apps tended to use gamification techniques in secondary sections (e.g., profile page, self-tracking page ..etc.).

3.5 Age

In the expert-interviews, juiciness or using juicy game design (providing feedback using visuals or sounds) were mentioned by three of the participants as a potentially suitable technique for young people, which was a new technique that was not previously observed in the app-reviews phase. For example, Expert 7 mentioned: *“and maybe the younger kids tend to want more juicer feedback. But I think if you look at Candy Crush, for example.. You love to see the candy split from your eyes because it's nice feedback for the eye, you know?”*

As a generic consideration related to applying gamification for young age groups, it was suggested to have a higher quality design complying with the age group experience of gamification as mentioned by Expert 6: *“It is useful to keep in mind is perhaps that the younger categories have most of them played more games than the older categories. So, they might have a higher requirements on quality overall when it comes to the game experience”*

Regarding applying gamification and nudging design within the age range of 13 to 25 years old, most participants did not see the need for adjusting the design for different age subgroups, while adjusting it for gender and culture seemed to be more important as mentioned by Expert 6 *“Cute animal or cats or whatever, right, they seem to hit everyone between 13 and 25, I think you have a more of a problem with gender in this case.. I would argue that avatars in games to try to encourage both female and male aesthetic”*.

4 DISCUSSION

Mental health apps as designed online interventions witness several challenges in both short-term and long-term user engagement which consequently would affect the desired health outcome expected from these apps. Gamification and nudging design techniques could help in tackling this problem, and from the results it could be seen that there are several approaches that could be adopted to serve this objective.

4.1 Gamified design

A generic observation in the reviewed apps, is that gamification was included without a clear objective, and it was not directly connected with a specific health outcome. For example, the user may get points but there is no feedback on why and how to use the acquired points. [Nicholson \(2015\)](#) pointed out how the need to design a meaningful gamification experience by using concepts such as providing information and creating a story around the progress of the users, which could play a role in integrating the gamification design into the context of the mental health intervention. Additionally, it was found that to design a better mental health app intervention, gamification techniques in mental health apps should focus not only on increasing app engagement but also on supporting health behaviour change techniques that represent real health progress (e.g.: earning more points in the app representing a real progress in the user's mental health condition) ([Cheng et al. 2019](#)).

Even though all reviewed apps were found to be using at least one gamification technique, the increase in the number of techniques did not correspond to an increase in engagement. This could be an indication that it is more important to focus on the quality of design for gamification and setting up a clear plan for a gamified design, instead of focusing on adding gamified elements to the app as an objective by itself.

Setting smart goals presented by [Les MacLeod EdD \(2012\)](#) could help in assessing the design of gamification and guiding it toward more realistic implementation by defining a Specific purpose of applying gamification; setting Measurable effects; Assuring achievable outcomes; be Relevant to the application and to the health intervention; Time-bounded by having a time frame for the technique; and for the technique to be Engaging and Rewarding for the users which could be summarized in the word SMARTER.

A specific gamification technique that was found in this study to be potentially useful for both long-term and short-term engagement is creating a narrative by using app characters in a mental health context. Playfulness could also be utilized in generating this kind of engaging narration, as presented by [Legaard \(2020\)](#) who described different forms of aesthetics that could be used in this regard such as storytelling and creating specific personal characteristics for the app design, which could help the user engage with the intervention on a cognitive and emotional level.

4.2 Nudging in design

It is important to acknowledge that designing a nudge for a specific health behaviour change will not have the same effect on all users, while one nudge could be effective for some people, the same nudge could be useless or even harmful for others if applied without proper consideration ([Sunstein 2017](#)). The assumption that one nudge could fit everyone's desires is a false conception, as additional to the subjective effect of nudges one study shows that people have different acceptance responses for nudges especially the ones designed for social impact ([Hagman et al. 2015](#)).

Therefore, evaluating the designed nudges is a crucial step for maintaining sustainable health behavioural effect. [Lockton et al \(2017\)](#) proposed eight lenses to help in designing and evaluating the behavioural effect of the app which could be taken into consideration when designing nudges for mental health. The lenses proposed by Lockton aim to check if the designed item is error free, secure, interactive, engaging by playful features, perceptual, and what are the specific cognitive effects induced by the potentially applied behavioural economics concepts.

The simplicity in design as a nudge for engagement was also a noticeable factor for improving daily engagement in this study. The simple design of the user interface in “Calm” for example had the highest daily duration engagement rate with an average 20 minutes of daily use. This was found to be consistent with a study that recommends using simple UI as a main characteristic for high-efficacy and reducing cognitive demand in mental health apps ([Chandrashekar 2018](#)). Additional to the simple design, the proper use of colours in the UI also could play a role in improving mental health by reducing the cognitive demand as the short-wavelength colours (e.g.: blue colour) have been found to induce post-stress relaxation ([Minguillon et al. 2017](#)).

4.3 Design for age and personalization

A design technique that was suggested to suit the young age group in the study, is to use juicy design elements (providing interactive visual and audial feedback). While no studies were found connecting juiciness with age criteria (13-25), one study shows that the concept of juiciness could be used in improving user experience by supporting the psychological needs and reinforce intrinsic motivation, autonomy, and relatedness ([Hicks et al. 2019](#)). This could be hypothetically appropriate in mental health apps because such interventions require engaging and motivational loops, still further studies are needed to investigate how to adapt this design technique for mental health and how to ensure that it would not cause possible reversal effects (e.g., increase stress by raising cognitive demands or irritation).

In the results, personalization in design seemed to be positively influencing the frequency of apps use (number of sessions per day), also personalization was suggested for meeting gender and cultural differences. A concept called “Personalized nudging” could be used for nudging for behaviour change, which is based on providing nudges for users based on their usage data to deliver different experiences according to user needs and personal features ([Yeung 2017](#); [Mills 2020](#)). This new concept is quite interesting but also controversial, as on the positive side it could allow solving the problem of nudging behaviour change based on the user's personal differences such as mental conditions, gender, age, personality, and other personal variables. Still, on the other hand, it may lead to violations in user data privacy or discrimination in health outcomes if it was applied irresponsibly.

4.4 Implementation and future research

This study presents potential effective designs in gamification and nudging to improve engagement (onboarding, retention, duration, and frequency of use) for designers to achieve better mental health behaviour change. It is recommended that external validity of the apps is further investigated in future studies to be able to generalize results. Elements to consider are aspects such as gender, age groups, and different socio-economic status. Additionally, it seems that there is a great need for future investigations into how to apply behavioural change theories in gamification and nudging techniques to reach both engagement and mental health behavioural change objectives. The literature indicates that there is a significant intersectionality between behaviour change techniques on the one hand (Michie et al. 2011) and gamification and nudging techniques on the other hand (Hunicke et al. 2004; Sunstein 2014; Cheng et al. 2019).

4.5 Limitations and Conclusion

There are two main limitations of this study. Firstly, the nature of anonymous engagement data with no connection to age, gender or other personal factors such as socio-economic status, could limit the ability to generalize the results. Secondly, the qualitative analysis of app design may serve in identifying the used techniques, but it is not sufficient to draw a conclusion on how to qualitatively design the optimal techniques for engagement.

In conclusion, gamification and nudging design are commonly used nowadays in mental health apps aiming for behavioural change objectives. From study findings, a high potential for using gamification and nudging techniques to improve user's engagement with mental health apps were found, but to have such successful application, good planning for design objectives and a meaningful design should be adopted to meet the user's needs.

Design techniques such as using app characters or avatars to create app narrative found to be potentially useful for improving retention, in addition to the use of non-forcible nudging language.

For improving daily duration, in general, the use of nudging techniques was found to be more useful than gamification. The simple user interface and "Eliciting implementation intentions" nudge, showed better potential for improving the daily duration of use.

The gap in age (from 13 to 25 years old) was not problematic regarding tailoring the design in gamification or nudging, while adapting it to gender differences was suggested. In regard to the age range, juicy feedback in gamification (Juiciness) was suggested to have a better user experience for the younger age group, but further studies are needed to validate this finding.

Overall, this study furthers our understanding of how the elements of gamification and nudging are used in mental health apps. This study also illustrates what is still not fully understood about how these techniques can be employed for optimal design. Further studies are needed to support the qualitative design for behaviour change in mental health apps using validated behaviour change techniques, taking into consideration the high intersectionality between design, psychology, and user-centric approach.

REFERENCES

- Arno, A. and Thomas, S. (2016) 'The efficacy of nudge theory strategies in influencing adult dietary behaviour: a systematic review and meta-analysis', *BMC public health*, 16(1), 676. <https://doi.org/10.1186/s12889-016-3272-x>
- Bakker, D. and Rickard, N. (2018) 'Engagement in mobile phone app for self-monitoring of emotional wellbeing predicts changes in mental health: MoodPrism', *Journal of Affective Disorders*, 227, 432-442. <https://doi.org/10.1016/j.jad.2017.11.016>
- Bauer, M., Glenn, T., Geddes, J., Gitlin, M., Grof, P., Kessing, L.V., Monteith, S., Faurholt-Jepsen, M., Severus, E. and Whybrow, P.C. (2020) 'Smartphones in mental health: a critical review of background issues, current status and future concerns', *International journal of bipolar disorders*, 8(1), 1-19. <https://doi.org/10.1186/s40345-019-0164-x>
- Baumel, A., Muench, F., Edan, S. and Kane, J.M. (2019) 'Objective user engagement with mental health apps: systematic search and panel-based usage analysis', *Journal of medical Internet research*, 21(9), e14567. <https://doi.org/10.2196/14567>
- Chandrashekar, P. (2018) 'Do mental health mobile apps work: evidence and recommendations for designing high-efficacy mental health mobile apps', *mHealth*, 4. <https://dx.doi.org/10.21037%2Fmhealth.2018.03.02>
- Cheng, V.W.S., Davenport, T., Johnson, D., Vella, K. and Hickie, I.B. (2019) 'Gamification in apps and technologies for improving mental health and well-being: systematic review', *JMIR mental health*, 6(6), e13717. <https://doi.org/10.2196/13717>

- Glenn, D., Golinelli, D., Rose, R.D., Roy-Byrne, P., Stein, M.B., Sullivan, G., Bystritsky, A., Sherbourne, C. and Craske, M.G. (2013) 'Who gets the most out of cognitive behavioral therapy for anxiety disorders? The role of treatment dose and patient engagement', *Journal of consulting and clinical psychology*, 81(4), 639. <https://psycnet.apa.org/doi/10.1037/a0033403>
- Hagman, W. (2018) When are nudges acceptable?: Influences of beneficiaries, techniques, alternatives and choice architects, unpublished thesis, Linköping University Electronic Press. <https://doi.org/10.3384/diss.diva-152788>
- Hagman, W., Andersson, D., Västfjäll, D. and Tinghög, G. (2015) 'Public views on policies involving nudges', *Review of philosophy and psychology*, 6(3), 439-453. <https://doi.org/10.1007/s13164-015-0263-2>
- Hicks, K., Gerling, K., Richardson, G., Pike, T., Burman, O. and Dickinson, P. (2019) 'Understanding the effects of gamification and juiciness on players', in *2019 IEEE Conference on Games (CoG)*, IEEE, 1-8. <https://doi.org/10.1109/cig.2019.8848105>
- Hoffmann, A., Christmann, C.A. and Bleser, G. (2017) 'Gamification in stress management apps: a critical app review', *JMIR serious games*, 5(2), e13. <https://doi.org/10.2196/games.7216>
- Hunicke, R., LeBlanc, M. and Zubek, R. (2004) 'MDA: A formal approach to game design and game research', in *Proceedings of the AAAI Workshop on Challenges in Game AI*, 1722.
- Hwang, W.J. and Jo, H.H. (2019) 'Evaluation of the Effectiveness of Mobile App-Based Stress-Management Program: A Randomized Controlled Trial', *International journal of environmental research and public health*, 16(21), 4270. <https://doi.org/10.3390/ijerph16214270>
- IHME (2019) The Institute for Health Metrics and Evaluation - Global Burden Of Disease Compare | Viz Hub, available: <https://vizhub.healthdata.org/gbd-compare/> [accessed 10 December 2020].
- Legaard, J.F. (2020) 'Designing aesthetics for play (fulness)', *DS 101: Proceedings of NordDesign 2020*, Lyngby, Denmark, 12th-14th August 2020, 1-12. <https://doi.org/10.35199/norddesign2020.44>
- Les MacLeod EdD, M. (2012) 'Making SMART goals smarter', *Physician executive*, 38(2), 68. PMID: 23971403.
- Lockton, D. (2017) 'Design with intent and the field of design for sustainable behaviour' in *Living labs Springer*, 75-88. https://doi.org/10.1007/978-3-319-33527-8_7
- Matjasko, J.L., Cawley, J.H., Baker-Goering, M.M. and Yokum, D.V. (2016) 'Applying behavioral economics to public health policy: illustrative examples and promising directions', *American Journal of Preventive Medicine*, 50(5), S13-S19. <https://doi.org/10.1016/j.amepre.2016.02.007>
- Michie, S., Ashford, S., Sniehotta, F.F., Dombrowski, S.U., Bishop, A. and French, D.P. (2011) 'A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: the CALO-RE taxonomy', *Psychology & health*, 26(11), 1479-1498. <https://doi.org/10.1080/08870446.2010.540664>
- Mills, S. (2020) 'Personalized nudging', *Behavioural Public Policy*, 2020/04/13, 1-10, available: <http://dx.doi.org/10.1017/bpp.2020.7>.
- Minguillon, J., Lopez-Gordo, M.A., Renedo-Criado, D.A., Sanchez-Carrion, M.J. and Pelayo, F. (2017) 'Blue lighting accelerates post-stress relaxation: Results of a preliminary study', *PloS one*, 12(10), e0186399.
- Moore, A.W., Gruber, T., Deroose, J. and Malinowski, P. (2012) 'Regular, brief mindfulness meditation practice improves electrophysiological markers of attentional control', *Frontiers in human neuroscience*, 6, 18. <https://doi.org/10.3389/fnhum.2012.00018>
- Nicholson, S. (2015) 'A RECIPE for Meaningful Gamification' in Reiners, T. and Wood, L. C., eds., *Gamification in Education and Business*, Cham: Springer International Publishing, 1-20. https://doi.org/10.1007/978-3-319-10208-5_1
- Sharma, M.P. and Andrade, C. (2012) 'Behavioral interventions for insomnia: Theory and practice', *Indian journal of psychiatry*, 54(4), 359. <https://dx.doi.org/10.4103%2F0019-5545.104825>
- Stawarz, K., Cox, A.L. and Blandford, A. (2015) 'Beyond self-tracking and reminders: designing smartphone apps that support habit formation', in *Proceedings of the 33rd annual ACM conference on human factors in computing systems*, 2653-2662. <https://doi.org/10.1145/2702123.2702230>
- Sunstein, C.R. (2014) 'Nudging: a very short guide', *Journal of Consumer Policy*, 37(4), 583-588. <https://doi.org/10.7551/mitpress/11974.003.0008>
- Sunstein, C.R. (2017) 'Nudges that fail', *Behavioural Public Policy*, 1(1), 4-25. <https://doi.org/10.1017/bpp.2016.3>
- Thaler, R.H. and Sunstein, C.R. (2009) *Nudge: Improving decisions about health, wealth, and happiness*, Penguin. <https://doi.org/10.1007/s10602-008-9056-2>
- Wang, K., Varma, D.S. and Prosperi, M. (2018) 'A systematic review of the effectiveness of mobile apps for monitoring and management of mental health symptoms or disorders', *Journal of Psychiatric Research*, 107, 73-78. <https://doi.org/10.1016/j.jpsychires.2018.10.006>
- Werbach, K. and Hunter, D. (2015) *The gamification toolkit: dynamics, mechanics, and components for the win*, Wharton School Press.
- Yeung, K. (2017) '“Hypernudge”: Big Data as a mode of regulation by design', *Information, Communication & Society*, 20(1), 118-136. <https://doi.org/10.1080/1369118X.2016.1186713>
- Zichermann, G. and Cunningham, C. (2011) *Gamification by design: Implementing game mechanics in web and mobile apps*, " O'Reilly Media, Inc."