My Lockdown Journal – a Gamified Journaling App supporting Citizens' Wellbeing during COVID-19 Lockdowns

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Abstract - **The COVID-19 pandemic, and the lockdowns in response to it, massively disrupted the daily routines of people around the world. To stay isolated at home for long periods can come at an extreme detriment to one's comfort, and although the pandemic brought with it a wave of digital applications with the aim of keeping people safe, few of these presented features that could directly support users' wellbeing.**

"My Lockdown Journal" was an app designed by the UCL IRDR Centre for Digital Public Health in Emergencies (dPHE) that presented opportunity for users to journal their daily activity over the course of lockdowns. It was rapidly developed using components of other dPHE projects and released in May 2020, garnering more than 1400 unique users across the world that recorded their activities over the course of 2 years. Activity records had high granularity, providing details on the type of activity, the time the user did it, their satisfaction with it, and their answers to some follow-up questions (e.g. activity location, whether it was online or virtual). Daily reporting was encouraged by three gamification features: (i) social media competition, (ii) badges, and (iii) a self-evaluative "analytics" page.

The app design and deployment are both presented in this paper alongside an evaluation of its gamification features. Overall, My Lockdown Journal demonstrated that journaling and activity recording provided valuable support to users while also generating a rich dataset of human behaviour during lockdowns that can be used to inform public health policy in the next pandemic.

Index Terms – COVID-19, Human Behaviour, Journaling, Gamification, Android App

1. INTRODUCTION

The worldwide spread of COVID-19 at the beginning of 2020 prompted governments of large countries to consider and enact various forms of lockdown measures, aiming to limit infection by restricting movement of the countries' citizens and their contact with one another via quarantines, curfews, self-isolation, and stay-at-home orders. Such disruptive measures, by forcing people's daily routines to be changed, without a doubt caused unprecedented impact on their physical and/or mental wellbeing [1]. Understanding these impacts is important for epidemiologists (those studying disease control across populations), human behavioural scientists, and policy researchers alike.

The health and wellbeing benefits of keeping a written 'journal' of one's activities are well-documented by psychological research literature [2-4]. Positive impacts on rates of anxiety, low mood and depression are shown when journaling through life-changing events such as disasters or periods of heightened risk – the COVID-19 pandemic and its subsequent lockdowns, therefore, could have their negative mental wellbeing effects on the global populace mitigated if those most vulnerable adopted journaling.

Despite this, there were no digital applications developed specifically for journaling during COVID-19 lockdowns. Generally speaking, technical solutions released as a response to the onset of the pandemic were more focused on physical health: Zoe [5], for example, allowed users to

record their symptoms if they were infected with COVID-19 to further understanding of the virus and how it affected its sufferers. Meanwhile, the WHO app [6] supported health workers by providing a repository of resources about COVID-19, enabling those on the front line to have access to up-to-date knowledge and training. These apps concentrated on understanding and combatting the virus' physical health effects, a very important set of aims in the context of a global pandemic, but thereby leaving a gap for a digital solution that focused on mental wellbeing and supported it via journaling.

When they identified this gap-in-the-market, the UCL IRDR Centre for Digital Public Health in Emergencies (dPHE) initiated the development of an activity journaling app, titled My Lockdown Journal, with the aim to allow users to record their daily activities and details about them 24 hours a day, 7 days a week. The journaling app provided users with support for their wellbeing, by itself a unique and valuable intervention, while simultaneously collecting their activity reports into a rich, granular dataset on their behaviour and how it changed over time during pandemic lockdowns. The activity reports could be used for research but also by users themselves to make sense of their potentially poor perceptions of time during COVID-19 lockdowns [7].

My Lockdown Journal's development was informed by the multipart, 4000+ participant survey "To Zoom or Not to Zoom" [8] (and its accompanying sub-study focused on positive and negative feelings in the pandemic [9]). The app's features included the core activity reporting mechanism alongside a small repository of up-to-date information regarding COVID-19 FAQs (developed with the public health training expertise of Transmissible). Usage of the app was encouraged via gamification techniques including an integrated, concurrent Social Media competition, "badge" functionality that rewarded users for activity reporting, and a self-evaluative "analytics" page which allowed users to look back on their reported activities and reflect on their daily habits. Such gamification was beneficial to all parties, encouraging users to regularly partake in the healthy activity of journaling while simultaneously ensuring that the resulting dataset was well populated and usable for statistical analysis.

This paper outlines the initial design and development, the final architecture and implementation, and the userbase demographics and usage habits of My Lockdown Journal. The study provides context for the app that is important to consider when analysing its resulting dataset and provides a blueprint for the development of similar apps that can be used across other fields of study.

The paper is structured into eight primary sections. Section 1 introduces the context and the final functionality of the app. Section 2 reviews related work. Section 3 details the design and development processes, while Section 4 dives into the final architecture and implementation. Section 5 further details the gamification systems of the app that distinguished it and strengthened its usage and output. Section 6 analyses its usage, providing statistics on user demographics as well as user retention. Section 7 presents a comprehensive discussion on the project's outcomes, summarising challenges that were encountered on the way and identifying strengths and limitations of the final output. Section 8 concludes the paper with key takeaways and a look into the future regarding the usage of gamified journaling apps in other contexts.

My Lockdown Journal was renamed My Activity Journal in August 2020 as lockdowns became more variable across the world. For clarity, in this paper the app is referred to simply as My Lockdown Journal.

2. Related Work

At the beginning of the COVID-19 pandemic, its mental health implications already appeared to be widespread, with early evidence suggesting that symptoms of depression and anxiety (16–28%) and self-reported stress (8%) were common psychological reactions across population groups [10]. Medical staff believed that they were fighting two contagions at the same time: the virus and the negative emotions it elicited [11]. Kumar & Nayar [12] provide evidence of a rapid increase in serious mental health issues across the global population post-onset of the pandemic, manifesting especially as anxiety and depression reinforced by the necessary behavioural changes to lifestyles people had to make due to stay-at-home orders [1].

To combat such health and wellbeing problems, the activity of keeping a written 'journal' is a supportive habit with benefits well-documented by psychological research literature [3, 13-14]. Journaling works as an expressive coping method [15], allowing users to judge their mental experiences, identify and process their negative emotions, and ultimately alleviate anxiety or negative responses to stressors [16-17]. Positive impacts on rates of low mood and depression are found when journaling through life-changing events or periods of heightened risk such as natural disasters [18]; the COVID-19 pandemic fit that mould and therefore presented an opportunity for journaling to support the wellbeing of all affected.

Self-reported data is often used in studies about mental wellbeing and daily activity during COVID-19 lockdowns, but almost all use surveys rather than journaling/diary studies. Surveys are subject to a few problems: although they're easy to use and non-invasive [19], they make the data subject to participants' selective and memory biases, are usually not temporally granular (unless repeated daily, in which case surveys almost become journals) [19], and present problems regarding participants' willingness to tell the truth (in COVID-19 lockdowns, where compliance was legally enforced, participants in a survey would not be inclined to report their activity if it was non-compliant) [20].

By journaling activities at the time they are done with My Lockdown Journal, users were less likely to have problems with memory biases. Meanwhile, by doing so, they built a dataset of their activities per day, allowing analysis to be at

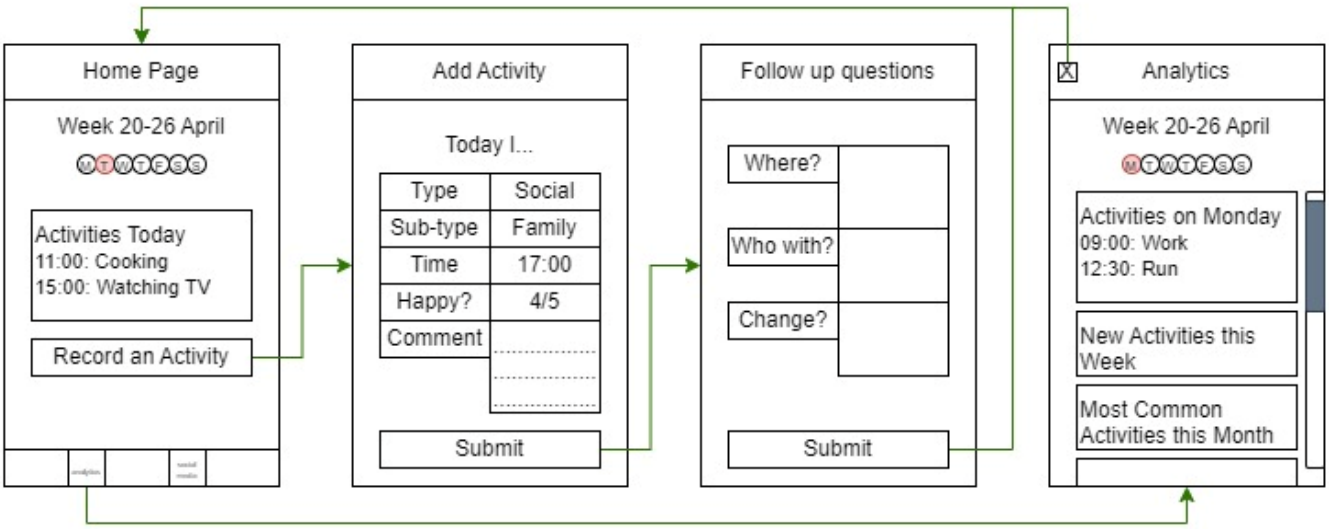

FIGURE I
THE MAIN FUNCTIONALITY OF THE APP, PRESENTED AS A WIREFRAME

a greater level of granularity than survey studies. Finally, given journaling is an introspective activity, recording of non-compliant activity would likely be less disincentivised than in a survey (by nature of participants seeing no clear repercussions for illegal activity reports [21]).

3. DESIGN AND DEVELOPMENT

3.1. Requirements Analysis

Requirements for the functionality of the MyLockdownJournal app were conceptualised and planned with the MoSCoW method. This resulted in design priorities being: accessibility on both iOS and Android; global availability; activity reporting to a high level of granularity (e.g. recording type of activity, time, duration, satisfaction, and user comments); gamification via self-analytics and awards; presentation of up-to-date COVID-19 related health and safety information to users; and social media linkage.

3.2. Wireframe and Artwork Design with Focus Groups

From the requirements analysis, an initial wireframe was created (Figure 1). This outlined the main functionality of the app – journaling via daily activity recording, with self-analytics to allow introspection. Artwork and design decisions were made with the support of rapidly recruited participants of online focus groups, who provided recommendations and iterative input on app features and layout.

3.3. App Features

The app had three pages as part of its core functionality. Each had artwork, with the mascot of a jumping fish appearing often as selected by focus groups as a mentor and symbol of activity and liveliness.

On the home screen, the mascot fish would present an inspirational, positive message randomly selected from an internal repository within the app's files. Here users could select days of the calendar and see what activities they had recorded on those days.

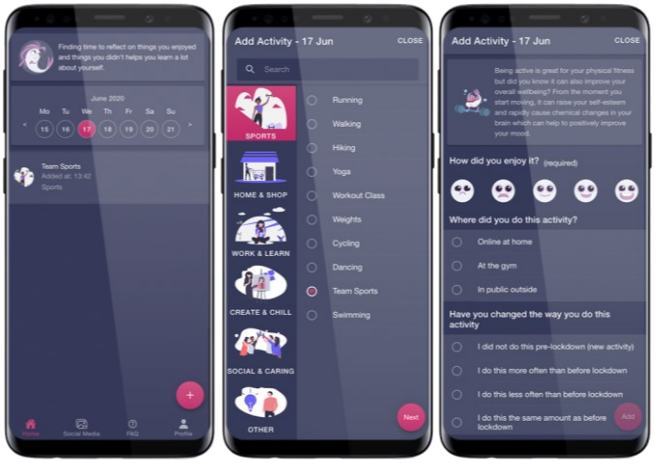

FIGURE II
FROM LEFT TO RIGHT: THE HOME PAGE, THE ACTIVITY REPORTING PAGE, AND THE FOLLOW-UP QUESTIONS PAGE

The activity reporting page allowed selection of two levels of detail to describe the category and sub-category of the user's activity, prompting users to record in a structured way. The following page would allow them to record time and duration.

The follow-up questions page allowed users to record qualitative details about their activity. Accompanied by the fish mascot at the top with a message relevant to the chosen type of activity, users would rate their satisfaction with the activity, where they did it, with whom, and whether they had changed the way they did the activity since the onset of lockdown. These questions were dynamically updated over the course of the pandemic to reflect the changes in restrictions and overall stringency of lockdown. Here, at the bottom of the page, users could write a journalling entry into

a free-text field. Activity records could be edited and changed retrospectively by the users.

Additional pages included "Awards", "Analytics", and "Social Media", all of which will be discussed in section 5.

4. Architecture and Implementation

4.1. Technical Architecture

The app was built upon the Ionic React Framework (for Front-End functionality), Redux, TypeScript (for Back-end functionality), and MongoDB (for databasing). Due to time constraints, the app was limited to Android devices only.

4.2. Main Functionality and User Flow

The main functionality of the My Lockdown Journal revolved around users recording the activities they did over time. Once a user had entered their details (age, gender, location) and created a profile, they could begin to log their activities from the home page of the app. To do so, the user would select the main category of the activity they wanted to log (i.e. whether it belonged to the category of Home, Work, Sport, Social, Creative, or Other), and then chose a sub-category or entered the name of their activity themselves. The user could select the time and duration they had done the activity, enter a comment (optional), and rate their satisfaction with the activity out of 5 stars. They could finally answer the follow-up questions (optional), where they were asked about activity location, whether participation was virtual or physical, or changes in the frequency they do the activity over time.

Once the user saved this activity log, it was stored in the database hosted on a secure server, retrievable by the user for viewing/modification. The data was anonymised for use in research, with ethical approval for the study granted by the UCL Ethics Committee.

4.3. Data Output

While the main goal of the gamified app was to provide a real-world intervention to improve wellbeing and support people during lockdown, the MyLockdownJournal app produced invaluable data categorised in 7 datasets represented as tables in MongoDB. The main dataset, "Activities", stored information on all recorded activities that users inputted. Each row represents one recorded activity, with the data fields being:

- **id** (string): Unique identifier for the activity
- **category** (string): The main category the activity belongs to, i.e. Home, Work, Sports, Social, Creative, or Other.
- **commentBox** (text): User comments.
- **createdAt** (DateTime): The time the activity was created.
- **followUpAnswers** (JSON): A JSON object containing the follow up questions asked and their answers.
- **rating** (integer): The satisfaction rating the user gives the activity, from 0 to 4 (representing the user's choice of 1-5).
- **type** (string): The subcategory chosen by the user that describes the activity best.

The "Users" dataset meanwhile contained all data on the users themselves – their user ID, gender, age range, country, and city, as well as date of registration. The "Logs" dataset stored data on when users did anything on the app, with rows containing each individual activity, the date it was done, and the user that did it (via their user ID). The "Weekly Activities" dataset collected all activities done by each user over the course of a week with each row containing the week, an array of these activities (via their unique IDs), and the user ID they correspond to.

The "Bugs", "Feedback", and "Notifications" datasets are all self-descriptive and not relevant to this research.

The datasets were translated from JSON into .csv files for analysis after support for the app ended

5. App Gamification

The app contained additional functionality with an analytics page (for users to visualise their history of activities), an awards page (location of user incentives, which were virtual "badges" received by users who reached milestones regarding their activity reporting), and a social media page (with links to the My Lockdown Journal Instagram/Twitter accounts, which contained parallel social media campaigns to provide further incentives for users). Besides the latter, these gamification elements were inspired and adapted from recommendations by Krath et al. [14].

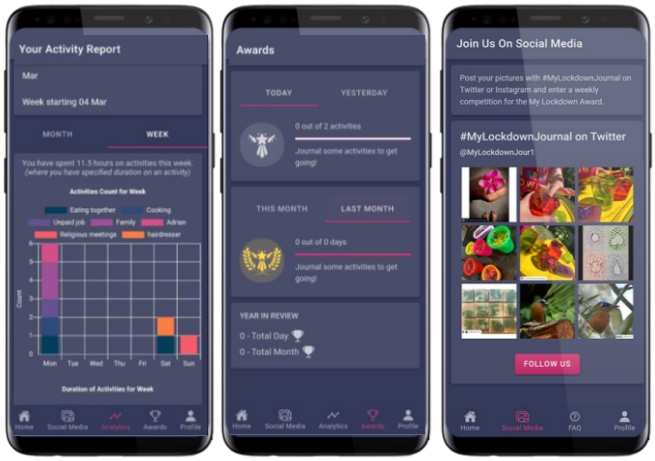

FIGURE III
FROM LEFT TO RIGHT: THE ANALYTICS PAGE, THE AWARDS PAGE, AND THE SOCIAL MEDIA PAGE

5.1. Analytics and Gamification via Self-evaluation

The analytics page of the app had two intended effects. The first was to benefit the user: self-evaluation of activity reporting habits provided users the chance to reflect on their habits, identify activities they did too much (or not enough), and ultimately keep a sense for the passage of time as lockdowns went on. On the other hand, the analytics page also provided gamification: such self-evaluation and

introspection leads to self-competition (by incentivising users to set their own individual goals, as suggested by Krath et al. [14]) in this case having users see the frequency with which they historically recorded activities on the app and therefore encouraging them to keep that frequency or improve it as time went on.

Self-evaluation worked as a reinforcer given the fact that activity reporting, i.e. journaling, is an activity with positive self-impact that is often performed less by users than they themselves think they ought to. Upon reflection on past good habits (frequent journaling) or bad habits (infrequent journaling), users can therefore identify (via the analytics page) whether they should keep or increase their daily use of the app.

5.2. "Badges" and Gamification via Awards

Users could track their progress via a "badge" system that rewarded them for reaching certain milestones. The badges were a permanent reward that could be found on the user's "awards" page.

Badges could be weekly, monthly, or yearly, and were awarded for either reporting a milestone amount (e.g. reporting 10 activities in a week) or reporting an activity they hadn't reported before.

Although they were purely virtual, representing no real-life gain for users reaching a milestone, the badges nonetheless provided a source of gamification. Peng et al. [22] finds this to have an effect on habits by fostering feelings of competence, incentivising reaching milestones without any need for tangible or physical rewards, instead, being informative in nature about users' progress and performance [23].

5.3. Social Media Challenges and Gamification via Community

Users were encouraged through the app to post media and comments related to their daily activities on Twitter (now X) and Instagram under the hashtags #myactivityjournal and #mylockdownjournal with a mention to the My Lockdown Journal social media pages. At the end of the week for thirty-one weeks, users' social media posts were collected, with the most relevant, positive, and creative ones awarded a weekly award presented by a video post on the official social media pages. Images posted on Instagram were pulled via an API and automatically displayed on the app's Social Media page (utilising Instagram's enforced square size), providing users a quick and easy way to see what the community was doing and how they were handling the lockdowns, inspiring them to do other activities or share their hobbies.

Building a sense of community was especially pertinent considering how lockdowns do the opposite: by enforcing isolation, loneliness was at never-before-seen levels during the harshest of stay-at-home measures, but even afterwards, when lockdowns were less stringent, the prevalence of COVID-19 meant that vulnerable people of all types (those with other health problems, those in old age, those with health anxiety) stayed inside and could never return to community as it was before the pandemic. An online community where people could not only see others' activities every week but also talk about their own (in the comments of My Lockdown Journal social media posts) therefore helped relieve loneliness and isolation, in turn boosting popularity of the app and its usage.

6. App Usage and Data Collection

6.1. Usage

The My Lockdown Journal app was active between May 2020 and March 2022 . Upon its release, the app was advertised via Facebook and Twitter advertisement for 2 months and was supported by a concurrent social media campaign that encouraged use of the app. After advertisement concluded, growth of the app was entirely organic.

The resulting data collected summed up to:

- 11900 activities recorded in the "Activities" dataset
- 1422 users registered in the "Users" dataset
- 1092 user-weeks in the "Weekly Activities" dataset
- 60320 in the "Logs" dataset

The logs identified that users clicked to see the Social Media tab 2582 times. Due to an unforeseen technical issue, they could not confirm when users used the "analytics" page or the "badges" page, limiting the ability to understand the success of the gamification.

6.2. User Demographics

For the sake of clarity, this and the following section analyses the demographics of the UK userbase only, given advertising was targeted towards internet users in the UK, meaning international users downloaded the app spontaneously.

Out of the 1422 users registered, 1041 were from the UK. Within the UK, users' self-reported locations were incredibly diverse, with users from 519 unique cities, towns, and villages.

UK users of MyLockdownJournal were predominantly female – 59.6% of users against 36.2% male (and 4.2% "prefer not to say"). The distribution of age ranges in the overall userbase was even; besides the most common age range (45-54 year olds, 21.3%) and the least common age range (65+, 9.22%), all other age ranges were represented almost equally among the sample.

6.3. User Activity and Retention

Another way to analyse user engagement and retainment is working out "User Lifetimes", taking the first log each user has and their last to build a representation of how long they used the app for. This is represented in Figure IV. It seems that the userbase surprisingly grew fastest in the period after advertisement ended (around October 2020), signifying organic growth was strong. Although lifetimes show extremely high variance, it should be noted that,

unfortunately, most are short (following a trend identified commonly in the serious games domain [24]). Nonetheless, it is interesting to see that users who downloaded the app towards the end of 2020 became the long-term user cohort.

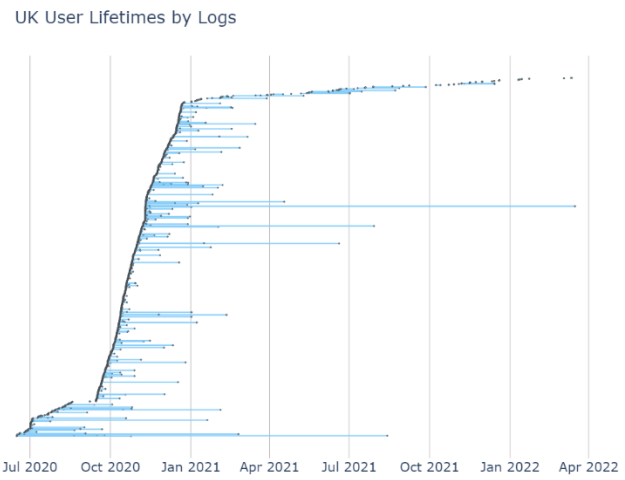

FIGURE IV
UK USER LIFETIMES, WHERE BLUE REPRESENTS TIME THE APP WAS IN USE BY A USER

6.4. Social Media Challenges

31 weekly challenges were run, from the app's release in May to the end of the year in 2020. Winning posts can be seen on the profile page of @ActivityJournal on Twitter (now X), consisting mostly of users' artwork, photography, and new hobbies taken up post lockdown (e.g. knitting, birdwatching, and even basketweaving). Hands-on activities were noticeably common and almost never spoken about with reference to the COVID-19 pandemic, perhaps pointing to escapism being a common mindset among participants.

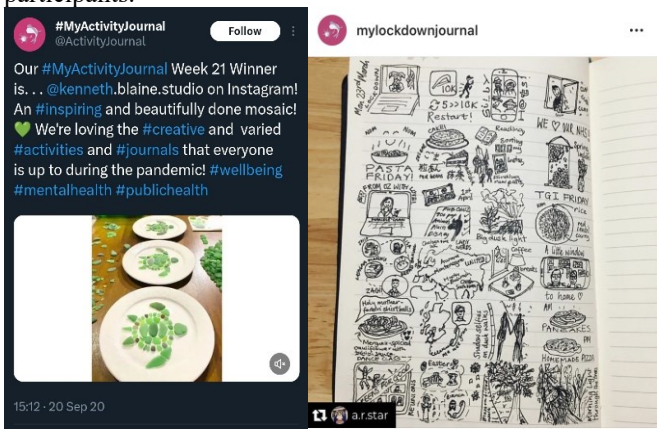

FIGURE V
TWO WINNERS OF THE SOCIAL MEDIA CHALLENGE AS FOUND ON TWITTER/X AND INSTAGRAM

Importantly, the Twitter account was very active, not only posting the winners of weekly challenges but also tweeting about admirable activities like volunteering that were in the news. The account would repost any tweets that mentioned it, boosting app users' posts and therefore acting as a central pillar of the burgeoning community formed among the userbase. As a result, a positive feedback loop formed, with the social media community encouraging its members to use the app, while its images were pulled into the app to encourage app users to click through to the social media pages for activity inspiration and engagement.

7. DISCUSSION

The development and deployment of My Lockdown Journal, and preliminary analysis of its data post-operation, presented the following key points of discussion.

- **The app was mutually beneficial** – at its core, My Lockdown Journal presented only benefits for both users and researchers. Users received the positive mental wellbeing effect of journaling, supplemented by the community created by the social media challenge and encouraged by other gamification techniques, while researchers received a rich, granular dataset on daily activity of a diverse sample of people over the course of the two years that will be topics of research for a long time afterward.
- **The app was technically straightforward** – development was not difficult as it involved building on previously used design and architectures in the dPHE's institutional memory. The gamification ideas (badges, self-analytics, and concurrent weekly social media challenges) are well known concepts in the field and did not need much adaptation to fit into this context. As a result, development went smoothly despite the pandemic making teamwork remote and meetings virtual. On the other hand, the nature of rapidly development as a response to the onset of the pandemic meant that time was constrained, leading the app to falter in its compliance to the requirements analysis by not being accessible on iOS.
- **The app engaged users across the world** – the app accomplished its aims regarding global accessibility, resulting in users from 68 countries. However, countries were not represented equally in the userbase, with the UK being by far the most populous. This was due to advertisement and promotion being focused in the UK, and the social media challenge being run in English. The result means that, although the dataset has global scope, it likely can't be used for generalised research and should be filtered to centre on a country with a large number of users for unbiased analysis.
- **Women were highly represented in the user base** – similar to the preceding Li et al. [6], women made up a majority of the data subjects. Further analysis can prove that they were also most active on the app, reporting activities more than men on average. It is well documented that women respond more to social media surveys/marketing [25], so this isn't unexpected. The outcome is not necessarily an issue but once again must be considered when using the dataset – biases can

manifest in analysis given societal gender biases towards certain activities.

- **User retention was low** – User lifetimes, on average, did not last much longer than a few months. Although this is in line with research [24], it causes longitudinal study to be difficult by making heterogeneity a big factor in statistical analyses of the data.
- **The app was modified over time** – As lockdowns changed in their nature, more was understood about how people were reacting to them. My Lockdown Journal had to adapt follow-up questions to activity reports in response (changing the questions to ask "where" the activity took place in an update after previously stringent initial lockdowns, in which all activity was done at home so such a question would have been redundant, for example). This in turn makes the users' answers to follow-up questions difficult to analyse without turning to more qualitative, textual techniques that can navigate heterogenous datasets better than quantitative or computational methods like sentiment analysis.
- **User feedback** – other than a couple of authentication problems, users reported no bugs with the app. The only technical bug came in log collection, where users' interactions with the analytics and the badges pages were not tracked.

7.1. Future Work

My Lockdown Journal's functionality and gamification makes its design useful across contexts. Work has been done within UCL to apply it for people living with obesity to journal their daily activity, with the gamification systems (aside from the social media challenge) working to encourage healthy habits by providing users ability for self-reflection and visible progress measurement. In this pilot, an alert system was developed to demonstrate how push-notifications could increase app usage after multiple days of inactivity, reminding users to do their "favourite" activity again, or encourage them to try a new one. Other features of the pilot included multi-user features to provide a level of encouragement and mutual support between people in a community.

The detailed, multifaceted data from MyLockdownJournal can be used to answer questions about human behaviour in lockdowns. By providing a dataset on daily activity, the app allows researchers a capability to perform either quantitative time series analysis on frequency of certain activities or qualitative textual analysis regarding users' answers to questions about their activities. Combined with other COVID-19 resources that have been made like the Oxford COVID-19 Stringency Index, there is potential for follow-up research that can provide insights on how people reacted to lockdowns with variable stringency – the topic of a paper being written in dPHE, using My Lockdown Journal data.

Other research across the field of public health could be facilitated by the data collected in the app. As psychologists might use the journal entries to understand the mindsets of users from different demographics or residential locations, so too could an exercise scientist use "Sport" activity records to estimate the effect of stay-at-home orders on physical activity. Furthermore, a researcher can use the entire dataset – including the data collected up to March 2022 – in order to build a comprehensive picture of users' lives through a tumultuous beginning of the decade.

Due to the sensitive nature of journal entries, the raw data collected by My Lockdown Journal will not be available to researchers outside of UCL dPHE (the privacy policy users agreed to, written with the advice of the UCL IRDR Ethics team, only allows vetted UCL researchers the ability to conduct research on the raw data, maintaining a solid guarantee that sensitive journaling data from users' personal lives will not fall into the hands of malicious actors). Nonetheless, aggregate datasets that are being built from the raw My Lockdown Journal data for use in an upcoming dPHE paper will be released upon the paper's publishing.

8. Conclusion

The disruption that COVID-19 lockdowns caused to peoples' lives was unprecedented, with severe impacts on physical and mental health. The design and development of My Lockdown Journal allowed users to record their daily activity, providing over 1400 users the positive mental impacts from journaling as well as a sense of community via concurrent social media challenges. These challenges were also part of the integration of gamification into the app's design, encouraging users to keep recording activities with the help of a "badges" system and a self-evaluative "analytics" page. In turn, this meant that the app collected a rich, granular dataset on daily activity and human behaviour over two years dominated by ever-changing lockdowns. The results of the app's data analysis will be of interest to epidemiologists, human behavioural scientists, and policy researchers alike in the context of future emergency response planning. It is hoped that the overall contribution of My Lockdown Journal to the field of public health will help to mitigate the wellbeing impact of the next pandemic.

Acknowledgement

Professor Patty Kostkova won "Innovator of the Year" at the Computing Women in IT Excellence Awards for leading the My Activity Journal project. dPHE won Team of the Year 2020 at the Computing Rising Star Awards, with this project a significant component of the team's nomination and victory.

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