

An analysis of productivity app strengths: An environmental scan

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ABSTRACT

Background

In recent years, productivity apps have become the most commonly used apps. While some may feel productivity apps work solely as a result of the placebo effect, productivity apps have been shown to have three major benefits: accountability, assessment, and improvement. Stress levels were especially reduced in the two meditation groups as opposed to the muscle relaxation group. Furthermore, there has been reported evidence on the effectiveness of app-based meditation and mindfulness in reducing stress and increasing productivity for users.

Methods

In order to answer the research question, published articles from ProQuest, Business Source Premier and Web of Science were used. Additionally, Harvard Business Review was also used as a source of grey literature. Information was collected in order to determine the strengths of competing productivity apps and how they could limit or be applied to the Felicity App. The research was reviewed based on screening tools that assessed validity and relevance. Included studies were published within Asia, North America, Australia, or Europe, and where either quantitative, qualitative, randomized controlled trial (RCT), surveys, experiments with participants, or academic studies. Study screening and extraction were completed independently among two authors. Disagreements following reconciliation between the two authors were settled by a third author.

Results

The selected articles discuss information including methods of improving productivity, mobile-based interventions that are effective at improving either overall health or productivity, and techniques that may be applicable to the Felicity App as a mobile-based intervention.

Conclusion

The results show that the Felicity App can improve user outcomes by integrating features from other applications.

Keywords

productivity apps AND mobile

INTRODUCTION

In recent years, productivity apps have become the most commonly used apps. In a 2019 survey, 496 participants reported their app usage. The survey revealed that productivity apps scored highest in terms of usage for 96.77% of participants [20]. “Productivity app” is an umbrella term for any software that increases efficiency and boosts productivity. The term has come to take on several iterations—from applications that decrease the amount of time it takes to complete a task by making the process more efficient, as well as applications that encourage individuals to increase their output while completing a task. Therefore, this environmental scan aims to analyze the current ‘market’ for productivity apps. Based on these findings, the strengths and areas of improvements of the *Felicity App* were analyzed. The *Felicity App* is a mobile productivity application which provides psychological interventions to young adults (15 to 40 years old). A comparison of our app-based interventions with other interventions will be done in this systematic review to answer the question: “How can the strengths of competing productivity apps limit or be applied to the Felicity App?”

To answer the research question, it is important to first consider the effectiveness of mobile app interventions to increase users’ productivity. Over the course of time, many branding companies have claimed that their app will help individuals become more productive, organized and help them manage their time better. However, are these claims based on evidence or simply speculation? Research suggests that productivity apps can increase efficiency by more than 34% [1]. On the simplest level, productivity apps work by helping individuals see how much they work, when they work and what they spend their time working on. While some may feel productivity apps work solely as a result of the placebo effect (one tells themselves they are being productive, and in turn they are), productivity apps have been shown to have three major benefits: accountability, assessment, and improvement.

When looking at accountability, productivity apps use tactics such as visualizations to help hold users to their goals of completing tasks that encourage and motivate them to keep going. In addition, with increasing levels of motivation, individuals are less likely to become distracted by minor things that can hinder their progress in completing tasks. For example, research surveys reveal that productivity decreases by 34% when working in a distracting environment [7]. Similarly, productivity apps can aid in helping individuals create personal assessments. These assessments can be centered around the way they are using their time and how long certain tasks take. From these assessments, when individuals are aware of the way in which they spend their time, they can take the necessary steps towards making a change. Lastly, a large benefit of productivity apps are making progress towards improvement. When individuals download such apps, they are likely interested in making a change and feel that these apps will help them reach this desired change.

Although productivity apps are getting increasingly similar in their functions, the *Felicity App* introduces novel mechanisms through an online medium to aid in productivity. This is done through great emphasis on emotional regulation, mindfulness and meditation which have all been shown to be correlated with increasing productivity. Therefore, *Carrington et al* conducted a study whereby the effect of mantra meditation, respiratory meditation and muscle relaxation were studied on stress levels in a cohort of 154 working young adults. Participants who followed one of these three strategies for approximately 6 months exhibited a significant reduction in stress levels. Stress levels were especially reduced in the two meditation groups as opposed to the muscle relaxation group [3]. Furthermore, there has been reported evidence on the effectiveness of app-based meditation and mindfulness in reducing stress and increasing productivity for users. An example of this is seen in a study conducted by *Lindsay et al.*, which studied the use of app/mobile-based meditation on stress reduction in a cohort of 153 adults experiencing stress. The study emphasizes that the highest reduction in cortisol levels was observed when mindfulness and acceptance training were used in conjunction to alleviate stress. These findings are promising and support the science behind many of the interventions implemented in the *Felicity App* speaking to the strength of the upcoming app [8]. Stress reduction has been extensively correlated with increased productivity as it allows individuals to concentrate on their task and complete it efficiently. For example, *Krishnamacharyulu et al* administered a questionnaire to participants where they scored their learning capacity, emotional regulation and ability to organize their time before and after completing a daily 30 minute meditation twice a day. The study showed that participants were able to significantly improve their time management, learning capacity and emotional regulation by the end of the study [23]. Altogether, this data shows that mindfulness practices have a significant effect on stress reduction which in turn allows for increased productivity. This knowledge in conjunction with the proven success and effectiveness of mindfulness mobile apps highlights the strength of the *Felicity App* as it focuses on several mindfulness interventions to maximize user productivity and wellbeing.

The focus on productivity in the modern world has created a demand for productivity apps which push users to work more efficiently. Optimizing user's productivity is the primary goal of the *Felicity App* which introduces evidence-based interventions for time-management, procrastination, motivation, well being and psychological capital. Although the use of interventions and psychological concepts grounded in literature makes this application very promising, there are some areas of improvements that can be focused on. Therefore, this environmental scan will answer the question: "How can the strengths of competing productivity apps limit or be applied to the *Felicity App*?" to maximize the success and efficiency of the *Felicity App*.

METHODS

To determine the strengths of competing productivity apps and how they could limit or be applied to the Felicity App, an environmental scan was conducted. The aim of this environmental scan was to analyze current circulating productivity apps through existing literature to help ensure the user enhancement of productivity with the Felicity App. This scan was conducted with the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines.

Study design & setting

This environmental scan investigated the strengths of competing productivity apps and how they could possibly limit or be applied to the Felicity App. The Felicity App is a mobile application aiming to increase the productivity of students and workers with psychological interventions. This is imperative as it can increase the success of students and workers. Essentially, students can retain academic goals, while workers can retain career/financial goals, by increasing productivity. Considering harrowing productivity statistics, it is vital to increase productivity. For example, the average employee is productive for less than 3 hours per day [2]. This not only costs employers billions of dollars in lost revenue, but it also restricts the retaining of career/financial goals by workers. By studying the strengths of current circulating productivity apps, certain qualities can be incorporated into the Felicity App and used to boost productivity.

A mixed-method study design was used to evaluate both qualitative and quantitative information [9]. Qualitative data determined which qualities of an application enhanced the productivity of their users (such as potentially increasing the number of reminder notifications sent to users, etc.) and whether those strengths could be integrated into the Felicity App. Quantitative data provided measurable results identifying patterns or trends regarding the certain strengths of a productivity app and the corresponding productivity of the user. Through a convergent synthesis integration approach in analyzing the data, all types of data were covered to provide an in depth systematic review of the research question.

Search strategy & criteria

The different kinds of literature (such as both published and unpublished studies based on the eligibility criteria of this study) were reviewed. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocol (PRISMA- P) guideline was used to confirm the scientific accuracy.

An experienced information specialist searched Web of Science, Business Source Premier, and ProQuest for the period of January 1992 to December 2020. To ensure finding all relevant studies on this topic a broad range of synonyms were used for the search (see Appendix 1 for the search strategy). For the grey implementation-focused literature, a search for documents in the Harvard Business Review was conducted. Also, using Google and Google Scholar, the

snowballing method was used to identify additional sources from references cited in various fact sheets, conference proceedings, and book chapters (refer to Appendix 2).

Information Sources and Searches

Based on the eligibility criteria of this study, various forms of literature were reviewed including peer-reviewed and grey literature. Searches in databases (Web of Science, Business Source Premier, and ProQuest) were conducted by researchers from June 6, 2021 to June 15, 2021. Studies were limited to the publication period between January 1992 to Present Day. Searches utilized keywords for procrastination, motivation, psychological capital, time management, and well-being, as well as overall productivity. To optimize relevance of topics within studies, various keywords were customized for the search (refer to Appendix 1.).

For grey implementation-focused literature, a search for documents was conducted from the Harvard Business Review (HBR). The Harvard Business Review is a general management magazine published by Harvard Business Publishing which covers a wide range of topics that are relevant to various industries, management functions, and geographic locations. These divisions include subtopics such as leadership, operations, marketing and finance. Documents found within each grey-implementation literature database were subjected to the same inclusion/exclusion criteria and research question as studies found within Web of Science, Business Source Premier, and ProQuest. Grey literature sources were preferentially selected from NGO (non-governmental organization) websites and IGO (international governmental organization) websites to enhance validity.

Inclusion & exclusion

The inclusion and exclusion criteria for this study were predetermined. Studies were only included if written in English, psychology-based, and published between 1992 - 2020. Eligible study designs included randomized controlled trials, meta-analysis, systematic reviews, and grey literature. Studies were deemed suitable if the studied demographic consists of human subjects between the ages of 15 to 40 that were not diagnosed with any medical complications. Studies consisted of both genders residing in developed countries. Furthermore, studies were only included if strategies and concepts were directly applied or could be manipulated for usage in a virtual setting. Fig. 1 depicts the SPIDER analysis.

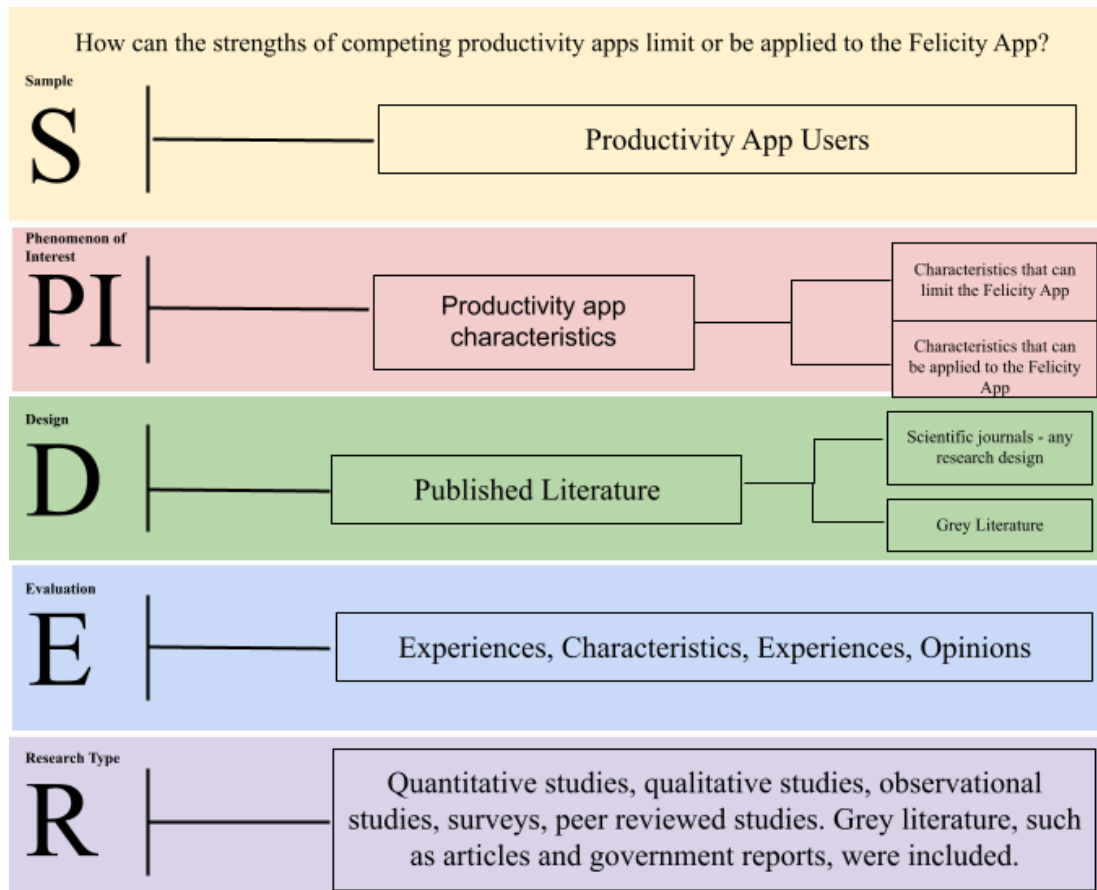


Fig. 1 Structural outline of SPIDER components that will be analyzed in this environmental scan

Data Collection and Abstraction

The articles that were gathered using the search strategy were put into the program EndNote X8. This was done so that any duplicate articles gathered from multiple sources could be removed. Using the research question, inclusion and exclusion criteria were determined. This was done so that a screening tool could be made. The screening tool, a questionnaire with 10 questions, excluded articles unrelated to the main research question. The screening tool reduced individual biases and provided an objective means of collecting data related to the research question. The articles gathered in the search strategy were screened by 2 authors, DK and RT. DK and RT used the screening tool to screen 218 articles.

Identification of Relevant Studies and Data Extraction

From June 6, 2021 to June 15, 2021, several databases were used to gather research articles. These databases were Web of Science, ProQuest, and Business Source Premier. Furthermore, the Harvard Business Review magazine was used to determine grey literature articles. 2 screeners (DK and RT) independently screened all articles (from both the databases and from grey literature sources) from June 15, 2021 to July 20, 2021. Then, DK and RT reconciled disagreements in whether an article passed or did not pass the screening tool. In the event that

DK and RT weren't able to reconcile disagreements, a third author, HD, would resolve the issue. The first round of screening (which involved screening the abstracts of 218 articles) resulted in 42 articles being produced. This round of screening (abstract screening) was done from June 15, 2021 to June 21, 2021. The second round of screening (which involved screening the entire text of the 42 articles that were produced from the first round of screening) produced 15 articles. This round of screening (full-text screening) was done from June 22, 2021 to June 29, 2021. Hand searches were done from June 29, 2021 - July 2, 2021. The first round of hand search screening was done from July 7, 2021 - July 13, 2021, and the second round of hand search screening was done from July 13, 2021 - July 20, 2021. Refer to Appendix 3 for a list of excluded studies.

Data Extraction

Database search extraction was done by authors JB and DQ independently, followed by reconciliation. Hand search extraction was done by authors KA and DQ independently, followed by reconciliation. The authors determined data such as study design, trend type, participant information, type of data collected, and significance of the trend (see Appendix 4 for Study Characteristics). All authors resolved disagreements during reconciliation. In the case of disagreements that arose, a third author resolved the disagreement.

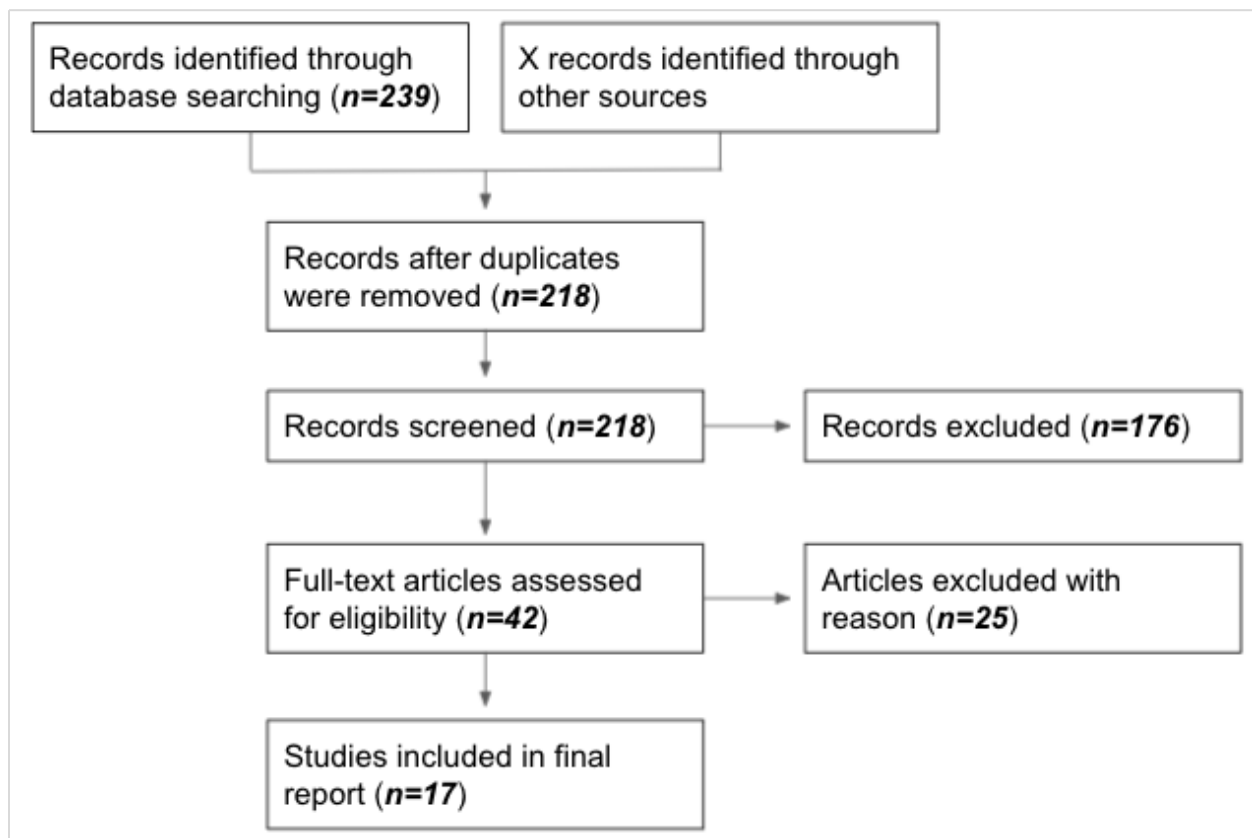


Fig. 2 Structural diagram of the completed screening and study selection processes

RESULTS

Study Selection

The study selection and screening process is illustrated in Figure 2. 239 papers were recognized through database searches, including 21 duplicates. After duplicated records were removed only 218 papers remained. Next, 218 articles were selected for abstract screening. Out of the 218 published studies 194 were retrieved from ProQuest, 14 were retrieved from Business Source Premier and 10 articles were retrieved from grey literature. The published and grey literature articles both underwent abstract screening and full-text screening. Only 42 papers were left after abstract screening and 176 papers were excluded. The 42 articles that were left after abstract screening consisted of 28 published articles and 4 grey literature. After full text screening only 17 articles were left, including 13 published articles, 3 grey literature and 1 duplicate paper. When performing hand searches 235 articles were obtained with 176 published articles and 59 grey literature selected throughout the process. After screening the hand searches only 31 articles were finalized. Within the 31 articles were 16 published articles and 15 grey literature.

Study Characteristics.

This study consists of 35 published articles which includes 16 qualitative, 2 quantitative, 9 voluntary participation examinations, 1 randomized control trial (RCT), 1 semi-structured interview, 2 academic studies, 1 student observations and attitudinal surveys, and 3 studies with unavailable information on the type of study design, duration, and participants involved.

Out of the 35 published studies included, 13 were from the United States of America; 3 from Canada; 4 from the United Kingdom; 3 from Germany; 1 from Israel, Spain and Greece; and 8 from unknown countries.

Findings and Outcomes

Findings from articles that were not relevant or did not answer the research question were not included. Of the 34 articles extracted only the best 15 were included in Table 1. Three articles discuss competitors in the market and their features for improving productivity. Seven articles found that mobile-based interventions are effective at improving either overall health or productivity. The last 5 articles provided more information on methods to stay productive along with information that may be applicable to the Felicity App as a mobile-based intervention. The outcome on how the Felicity App would be affected is listed in Table 1.

Table 1 Findings and outcomes of relevant articles

Article	Findings	Outcomes
Humana Launches Mobile App Designed to Improve Health and Social Engagement for Employers	A workplace with an established culture of wellness leads to	Felicity could implement some of Goal Guru's features allowing users to monitor their wellness

	<p>increased engagement and productivity of employees in company missions and goals.</p> <p>Mobile app, Goal Guru, monitors user's steps, weight and sleep along with other interactive features, such as allowing users to interact with each other through competitions and challenges, as a means of improving overall health of employees.</p>	<p>in order to increase productivity.</p>
<p>ThinkHR Launches Premium HR Solutions Suite To Give Insurance Brokers Competitive Edge:</p> <p>Workplace Pro includes a comprehensive and flexible compliance calendar and mobile app for a seamless experience that helps employers reduce risk and improve productivity</p>	<p>Workplace Pro includes a calendar directly regulated by ThinkHR's group of expert staff attorneys. Their new mobile app allows employees immediate access to HR questions and answers.</p>	<p>The Felicity App could include a moderated Q&A for users who require assistance.</p>
<p>Top ways to increase productivity; Maintaining a healthy balance in life helps efficiency</p>	<p>The human mind and brain are not made for heavy-duty multitasking. Suggests keeping track of how much time you devote to certain tasks everyday and performing the physical task of jotting things down.</p>	<p>The Felicity app could implement a feature for taking jot notes and a timer to limit the use of multitasking.</p>
<p>Behavior Change Techniques in mHealth Apps for the Mental and Physical Health of Employees: Systematic Assessment</p>	<p>Certain combinations of BCTs, such as providing information on link between behaviour and health or follow up prompts,</p>	<p>The Felicity app could implement features which are more geared towards long-term results such as follow-ups.</p>

	will have a higher chance of being more effective at improving health behavior.	
Top 10 Apps to Increase Your Productivity	To increase productivity competitors utilize checklists, email managers and planners.	The Felicity app could implement a feature for checklists or planning to increase productivity.
Match Your Productivity Approach to the Way You Work	People have different productivity styles. Some people prefer timing how long tasks take and others prefer flexibility and variety in their schedule.	Focusing on one type of productivity style will limit the audience the Felicity app attracts.
How Working Parents Can Get the Most Out of Calendar Apps	Misspent time is a result of letting others set your priorities. Set your priorities, set limits and practice time blocking.	A feature which allows users to practice time blocking could prove very effective at getting tasks done.
Effectiveness of an Internet- and App-Based Intervention for College Students With Elevated Stress: Randomized Controlled Trial	Internet- and App-based interventions reduce negative consequences of college-related stress.	The app can aim to reduce stress and thus increase productivity.
Evaluating online stress management intervention for college students	A correlation between lower levels of depression, stress and anxiety have been found with the element of control.	The Felicity app should allow users complete control to reduce stress and thus increase productivity.
MyStudentBody-Stress: an online stress management intervention for college students	Online stress management intervention is effective in increasing physical activity, prompting the use of specific stress	The Felicity app can utilize stress management methods to improve the overall health of users.

	management methods and decreasing overall anxiety.	
The benefit of web- and computer-based interventions for stress: a systematic review and meta-analysis.	Web- and computer-based interventions are effective in reducing stress, depression and anxiety. Guided interventions and interventions lasting <8 weeks are most effective.	Interventions in the Felicity app should be no longer than 8 weeks and should be guided to be effective.
Patients' experiences in a guided Internet- and app-based stress intervention for college students: a qualitative study.	Patients wanted more individualization/control, information regarding their situation, more specific to their situation related-support, shorter session lengths and less frequent reminders.	The Felicity app can provide background information and certain behaviour-health links, and provide the option for reminders and session length preference.
A randomised controlled trial of a brief online mindfulness-based intervention.	Online intervention was effective in significantly increasing mindfulness skills and decreasing perceived stress, depression and anxiety symptoms.	By practicing mindfulness, the user's overall wellbeing can improve.
Randomized controlled trial evaluating the effectiveness of a web-based stress management program among community college students	Participation in the web-based intervention resulted in participants having increased control and decreased depression, anxiety, perceived stress and symptoms.	Giving the user more control over what they can do on the app will lead to better health outcomes.
'Does digital game-based learning improve student time-on-task behavior and engagement in comparison to alternative	Trials showed that with DGBL there were higher levels of enjoyment along with student time-on-task	Positive reinforcement of being productive such as implementing games or challenges could increase enjoyment of users utilizing the

instructional strategies?'	behaviour and engagement.	Felicity app.
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DISCUSSION

I. Introduction

This environmental scan aimed to determine how the strengths and weaknesses of competing productivity apps could improve the *Felicity App*. This was done by analyzing over 200 scholarly articles which presented similar goals. However, the resources used were not uniform and articles used included, but were not limited to, qualitative data, quantitative data, surveys, and randomized control trials. This analysis culminated in a selection of key articles ($n = 15$) that would help address the main goal of the environmental scan. Presented below are the takeaways from the key articles and how they could be used to improve the *Felicity App*.

II. Strengths of Other Apps

With the advancement of new health-monitoring technologies that can measure physiological characteristics in recent years, tracking wellbeing has been easier for individuals. From tracking the number of steps walked daily to tracking heartbeat, innovative technologies allow for easy measuring of physiological characteristics. This strength has been utilized by other wellbeing applications, such as Humana, which monitor's their employees' physiological characteristics to encourage overall health and wellness [6]. Additionally, it is imperative that users focus on the app. Many other apps have utilized features that prevent multitasking to elicit complete focus from users. This includes keeping track of time spent on everyday tasks and physically jotting information down to reinforce it.

While improving outcomes often occurs with wellbeing apps, the persistence of these outcomes is difficult to maintain. To combat this, applications utilize features such as follow up prompts to ensure results are maintained in the long term.

Another important finding regarding control posits that control in one's life is associated with lower levels of anxiety and stress. This is why many online stress management systems for college students encourage complete user control of the application. This increases the overall wellbeing of individuals, thus producing improved productivity outcomes.

While it's important to improve the content of an application, app developers must consider the app experience itself (such as navigating the app, adjusting settings, etc.). The user experience is often regarded as the backbone of an app. A significant step apps have taken to improve the user experience is including a direct method of contacting a support team. This way, users have immediate access to answers and can continue enjoying the content of the app.

III. How Strengths Would Be Integrated Into The Felicity App

The *Felicity App* can integrate monitoring users physical health and wellness in addition to mental wellbeing to ensure maximal productivity and overall well being [6]. This can be done by including a habit tracker in the app whereby users can track their exercise, sleep and diet, as well as receive reminders from the app to continue practicing these habits.

Through this systematic review, it has been found that users engage more with productivity apps when there is a competitive or collectivist element [22]. Therefore, the *Felicity App* should integrate a way through which individuals can interact and compete with friends and mutuals in order to optimize user engagement and intervention compliance. This can be done through incorporating a feature that allows users to add their contacts into the application as well as adding a scoreboard feature. This scoreboard will show users their “friends” progress as well as their own, if they choose to share this information publicly. As such, monitoring their own progress alongside their acquaintances' progress will motivate individuals to continue completing interventions to increase their score, allowing them to obtain the best outcome from the app.

In addition to the collectivist approach, positive reinforcement was shown as a crucial element to maintain user engagement [22]. Although the *Felicity App* already incorporates this element through the implementation of growing avatars, this feature can be further developed. For example, an avatar shop can be introduced where new items become available to users as they follow interventions and complete interventions. Alternatively, users can obtain different badges as they reach new milestones. An important, and simpler, feature that can be implemented is a statistics page where users can see which aspects of their mental wellbeing and mindfulness journey they are excelling at and which aspects they need to strengthen [6]. This will allow users to fully take advantage of all the interventions available to them.

Finally, the importance of user control when following interventions was found to be crucial to increase user engagement as it decreases stress levels [5]. This is a crucial aspect that can be further enhanced through the *Felicity App* by allowing users to customize their interventions based on their goals for the day or week. In addition, the app can offer different variations of the same intervention based on the amount of time the user wants to spend on the interventions [4]. This will allow users increased flexibility and control, optimizing their engagement with the app.

IV. Weaknesses of Other Apps

Most calendar applications follow the same format whereby users input events, deadlines, meetings, and appointments into their calendar. However, this has been found to be less tactical and effective. Instead, it has been proposed that calendar apps should show users where they are spending their time and use this information to suggest a schedule for the user as well as implement reminders.

Vogel *et al.* found that gamification was not preferred as a teaching method when delivered through a computer-based format [24]. Instead, students benefited and accepted the gamification method when used by teachers whereas a traditional teaching method was preferred when using a computer.

V. Possible Similar Weaknesses in the Felicity App

The calendar app in the *Felicity App* allows users to type in entries into the calendar of meetings with people, upcoming assignments, appointments, etcetera. However, it has been reported that this traditional use of a calendar is less effective as it should also allow users to view where and how they are spending their time while also providing reminders to complete tasks or follow ups [21]. This can be integrated in the *Felicity App* by including an end-of-week statistics page which shows the user where/how their time was spent by breaking it into different categories (eg. ‘work’, ‘assignment completion’, ‘exercise’, ‘hobbies’, etc). By adding this feature to the calendar, the *Felicity App* will allow users to be proactive about their time management and take full advantage of the app.

Another limitation that applies to the *Felicity App* is that studies have shown that the use of gamification in an educational setting was less desirable for students when delivered through a computer [24]. It was reported that students preferred a regular educational format when using computer-based learning. This weakness is similar to the *Felicity App* as gamification is used as an intervention to enhance users’ wellbeing and motivation. Although the *Felicity App* will remain a mobile application, this limitation can be avoided through the use of a realistic avatar and voice system that can guide the users through the gamification interventions. Therefore, this guided format will keep users interested and increase their likelihood to enjoy and complete this intervention.

Strength and Limitations

This environmental scan aimed to search the literature to determine the strengths and areas of improvements of the *Felicity App*. This was done to answer the question “How can the strengths of competing productivity apps limit or be applied to the Felicity App?”. Although there are several strengths to this systematic review, there are important limitations to consider. The research question was answered through use of only three databases: ProQuest, Web of Science, and Business Premier. As a result, the systematic review does not fully explore all threats and opportunities in the productivity app market. Similarly, a lot of the sources examined were more focused on workplace or group settings which also narrows the scope of the review to this specific setting.

CONCLUSION

The use of mental health applications is on the rise. It is imperative that these mental health applications utilize effective interventions and resources to promote the best outcome for users.

By determining strategies, interventions, and resources used by similar applications, mental health applications significantly increase their chance at promoting the best outcome for users. It is for this reason that an environmental scan was conducted to determine how competing mental health applications optimize their interface, provide effective interventions for users, and ultimately help users as much as possible. It was determined that several strengths and weaknesses of other applications can be integrated into the Felicity App to improve outcomes for users. These results will be used to market the Felicity App to audiences upon release in late 2021.

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Code availability:

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Authors' contributions:

HD devised and supervised the environmental scan. KA conceptualized the environmental scan and designed the protocol. KA, JB, and DQ conducted the database search. RT and DZ completed preliminary and full-text screenings, JB and DQ completed the database extraction and analysis. KA and DQ completed the handsearch extraction and analysis. KA created figures and computed numerical data. KA, JB, DQ, RT, and DZ equally wrote the manuscript. All authors reviewed the final manuscript.

Appendix 1**Database Searches**

Date occurred (June 6, 2021 to June 15, 2021)

Database	Search	Results
ProQuest	(productivity app*) AND (mobile*) AND ((enhance*) OR (improve*) OR (increase*))	305
Business Source Premier	(productivity app*) AND (mobile*) AND (strength*)	30
Web of Science	(productivity AND app*) AND (strength*) AND (mobile*)	39

Appendix 2**Grey Literature Searches**

Date occurred (June 15, 2021 to June 22, 2021)

Database	Search	Results
Harvard Business Review	Productivity app*	17

Appendix 3

List of Excluded Files from Full Text Screening

Author/Journal	Title
M2 Presswire	There's a (business) app for that
Ginger & Any.do	Ginger and Any.do Partner to Boost Productivity While Messaging: Any.do, the award winning task management app, partners with Ginger to increase productivity while chatting on mobile
Wilson, H.J.	Imagining Productivity Apps for the Apple Watch
Good Technology	Good Technology Delivers Increased Developer Support and Ecosystem Integration for Good Dynamics Secure Mobility Platform: Ensures native, HTML5, and hybrid apps are secured and enterprise-ready
Realwire	Infostrada Sports and Roambi release iPhone and iPad apps to answer your London Games questions
PR Newswire	Trimble Introduces its FieldMaster Technician App to Enhance Mobile Workforce Productivity
PR Newswire	Snapsheet Moves to Intacct to Modernize Financial Processes and Support Future Growth: BT Partners Helps Auto Claims Mobile App Provider Adopt Cloud ERP to Empower Decision-Makers and Increase Productivity
PR Newswire	ExpertusONE Uses New Mobile Technology for Unprecedented LMS App Functionality: Innovative Presence Sensing, mobile reporting and contact share features dramatically improve learning adoption and productivity
M2 Presswire	Trimble Announces New Field Service Management Features to Improve Mobile Workforce Productivity
News Bites - Electronics	Trimble's New Construction Logistics Mobile App Provides Real-Time, Visual Data to Improve Operations

PR Newswire	hopTo Inc. Announces First Quarter 2015 Highlights and Results
Productivity Software	IMS HEALTH APPSCRIPT OFFERS MEDISAFE TO PATIENTS
M2 Presswire	TeamUltra launches TeamStore: an App Store for ServiceNow applications; ServiceNow Preferred Solutions Partner creates TeamStore for complementary Service Management apps, products and solutions
M2 Presswire	TeamUltra launches TeamStore: an App Store for ServiceNow applications
PR Newswire	NexTraq(R) Introduces NexTraq View(TM): Company Launches Powerful App with New Features to Enhance Real-Time Visibility of Fleet Assets and Provide the Power of Real-Time Productivity
PharmaBiz	Aprima partners with DocBuddy mobile workflow app to enhance physician productivity
PR Newswire	Aprima Medical Software Partners with DocBuddy Mobile Workflow App to Enhance Physician Productivity: Medical providers report saving more than 45 minutes per day
Business Wire	Microland Launches Global Mobile App for Its Digital Workforce to Enhance Business Productivity and Collaboration
ICT Monitor Worldwide	Sapho enables more apps on IBM Domino with its Micro App Platform
ICT Monitor Worldwide	SmartLinx Enhances Mobile App to Increase Employee Productivity
Business Wire	Kyield Offers Breakthrough Semantic Solution for the Challenges Facing Modern Organizations
BizWest	11 startups complete Techstars experience
Scientific Bulletin "Mircea cel Batran" Naval Academy	BYOD IN LARGE ORGANIZATIONS
Business Process Management Journal	An evaluation of the value stream mapping tool
Material Handling Product News	Track assets with automatic monitoring system, app
Overman, D.	Product Guide 2021: Practice Management

Eisenberg, D., et al.	Stigma and help seeking for mental health among college students.
Batterham, P. J., & Cleave, A. L.	Preferences for Internet-based mental health interventions in an adult online sample: findings from an online community survey
Sander, L., et al.	Effectiveness of Internet-based interventions for the prevention of mental disorders: a systematic review and meta-analysis
Deutsches Register Klinischer Studien	Online based self-help stress management program for students with feedback on demand
Zarski, A. C., et al.	Adherence to Internet-based mobile-supported stress management: a pooled analysis of individual participant data from three randomized controlled trials
TotalMobile	TotalMobile Launches Optimise, Designed To Further Empower A Mobile Workforce
Van den Heuvel, S. G., et al.	Productivity loss at work; health related and work-related factors
Anderson, I., et al.	Shakra: tracking and sharing daily activity levels with unaugmented mobile phones
Christmann, C. A., et al.	Stress Management Apps With Regard to Emotion-Focused Coping and Behavior Change Techniques: A Content Analysis
Lyons, E. J., et al.	Behavior change techniques implemented in electronic lifestyle activity monitors: a systematic content analysis
Morford, Z.H.	Procrastination and Goal-setting Behaviors in the College Population: an Exploratory Study
Rettig, H.	The 7 Secrets of the Prolific: The Definitive Guide to Overcoming Procrastination, Perfectionism, and Writer's Block

Appendix 4

Study Characteristics

Author, Date, Title of Study	Country	Study design, duration, and participants	Type of data	Identified Threats/Opportunities/Data - Outcome
Ross	US	Survey, 200 HR	Qualitative	Humana found that

McLerran/New York Business Wire, 2016 November 22, Humana Launches Mobile App Designed to Improve Health and Social Engagement for Employers		executives/managers and 500 full time employees	description through survey	employers who establish a defined workplace culture of wellness can achieve widespread positive impact on the health and productivity of their employees while increasing engagement in company mission and goals. Goal Guru allows users to participate in competition and engage with each other through wellness tracking, challenges and 24/7 interaction with a digital coach. Opportunity: If launched among felicity members, could run as a trial - benefit is that our app you don't have to pay for whereas in this app they paid for it
Anne Baker, 2016 March 16, ThinkHR Launches Premium HR Solutions Suite To Give Insurance Brokers Competitive Edge: Workplace Pro includes a comprehensive and flexible compliance calendar and mobile app for a	US	n/a	Qualitative description	Workplace Pro includes a compliance calendar that is automatically populated with compliance deadlines, and a mobile app that enables employers to get immediate answers to critical HR questions

seamless experience that helps employers reduce risk and improve productivity				
2017 May 13, Top ways to increase productivity; Maintaining a healthy balance in life helps efficiency	Canada	n/a	Qualitative description	Research has revealed that the mind and brain were not designed for heavy-duty multitasking. Calculate how much time you're devoting to certain parts of your workday. The physical task of writing things down and crossing items off the list one-by-one can help you sail through tasks effectively. If you're a mobile person, jot the list down on the notes function of a smartphone or use a task app that syncs with calendar functions.
de Korte et al., 2018 October 3, Behavior Change Techniques in mHealth Apps for the Mental and Physical Health of Employees: Systematic Assessment	Canada	Comparative assessment of 45 apps aimed at reducing physical, and psychosocial risks at work. December 2014 - April 2015	Comparative qualitative study	Top 3 most used BCT's: Provide information on behaviour-health link, provide instruction, time management. Top 3 least utilized BCT's: Stress management, prompt identification as a role model, agree on behavioural contract. Dusseldorp et al concluded from their meta-analysis that specific combinations of BCTs increase the likelihood of achieving change in health behavior, whereas other

				<p>combinations decrease the possibility. BCT's: Relapse prevention and follow up prompts may be of value long term.</p> <p>Opportunity: from their suggestion to increase potential and effectiveness, a collaboration between app developers, health behavior change professionals, experts on physical and mental health, and end-users is suggested.</p>
Li et al., 2018, Can a Game-based Productivity Tool Improve Procrastination?	Greece	Test Run & Technology acceptance model questionnaire, tested by 81 users	Qualitative description through questionnaire	<p>procrastination factors: task aversiveness, time of reward and punishment, impulsiveness and conscientiousness</p> <p>Opportunity: "They gave specific definitions for the different terms that they used while addressing theories - in their conclusion they suggested that the mechanic of converting real world tasks to story goals could be refined. How to accurately monitor the user's progress hasn't been addressed in this study yet. In addition, the behavior changes of using the proposed framework could be discussed.</p>
Jason Shueh, 2014 May 23, Top 10 Apps to	US	n/a	Qualitative description	Competitors: Clear - Checklists, CloudMagic - Email manager, Sunrise

Increase Your Productivity				Calendar - Calendar/planner, Trello - Project Planning and collaboration
Carson Tate, 2015 January 27, Match Your Productivity Approach to the Way You Work	n/a	n/a	Qualitative description	Personal Productivity Styles: Prioritizers and Planners - may time how long it takes to complete tasks in order to better plan, Visualizers - energized by task variety and schedule flexibility, Arrangers - looser time management policy
Alexandra Samuel, 2020 January 8, Create a Productivity Workflow That Works for You	n/a	n/a	n/a	n/a
John Hall, 2019 August 8, How Working Parents Can Get the Most Out of Calendar Apps	n/a	n/a	Qualitative description	Calendar Use - Outline your priorities first. The biggest culprit behind misspent time? Letting others set your priorities. -Set limits. Time blocking (or timeboxing)
Katherine Borthwick, 2014 December 2, Flowfinity Launches New App Editor for Faster Enterprise Mobile App Creation:	Canada	n/a	Qualitative description	Flowfinity Actions 8.0, the new app editor makes it easier to navigate through app fields, layouts, and pages, enabling apps to be customized with fewer clicks. Not much data

Flowfinity Actions 8.0 makes programming- free app configuration more intuitive and efficient				
Sarum PR, 2015 June 11, TotalMobile Launches Optimise, Designed To Further Empower A Mobile Workforce; A Resource Management Solution Developed To Manage A More Efficient And Productive Workforce	UK	n/a	Qualitative description	<p>Optimise provides total flexibility around how schedules are created - providing an important element of control</p> <p>Threat: Another app that poses a possible threat - TotalMobile is a 30-year-old software provider which specialises in innovative mobile-working solutions for public and private sector field workers. Its solutions are especially popular in health, social care and local government, being ideally suited to frontline workers who spend much of their time completing tasks in the community. The fast-growing company has over 25,000 users around the world, with customers spanning the UK, Ireland, Europe and North America.</p>
2016 April 11, Crestron Tackles \$37 Billion	US	n/a	Qualitative description	Crestron Pinpoint™ lets employees take control of every aspect of their

Challenge: The Cost and Frustration of Bad Meetings: New PinPoint(TM) Mobile App and Crestron Fusion(R) Cloud Platform Remove Bottlenecks and Improve Workforce Productivity				meetings, including scheduling, setup, execution and completion. With an awareness of an employee's location, it identifies nearby meeting rooms with the right technology and devices to meet their needs, and ensures a personalized, automated meeting experience.
Harsh Agrawal, 2020 August 21, 8 Tips for Bloggers To Increase & Maintain Productivity	n/a	n/a	Qualitative description	Tips on improving productivity: Time-management, To-do list, Disabling notifications, Pomodoro Technique
Jason Ankeny, 2013 June 21, Tempo AI raises \$10M to enhance iOS smart calendar app	n/a	n/a	Qualitative description	Tempo AI leverages artificial intelligence research and semantic technology to automatically connect the user's upcoming schedule of meetings and events to their emails, contacts and location data, enabling one-tap access to details like conference agendas, phone numbers, driving directions and travel itineraries. Users can also browse attendees' LinkedIn profiles, view foursquare and Yelp reviews and send a

				pre-populated "running late" email or text.
Harrer et al., 2018 April 23, Effectiveness of an Internet- and App-Based Intervention for College Students With Elevated Stress: Randomized Controlled Trial	n/a	2-armed randomized controlled trial was conducted with 150 (college students) participants. Self-report data were collected using a Web-based assessment tool	Quantitative randomized control trial	internet- and mobile-based interventions could be an acceptable, effective, and potentially cost-effective approach to reduce the negative consequences associated with college-related stress.
Hintz S, Frazier PA, Meredith L, 2015 April, Evaluating online stress management intervention for college students	US	Three armed randomized control trial, psychology students (n = 292), 3 week duration	Participation in interventions , scores on the Perceived Control Over Stressful Events Scale	Present control has been found to be associated with a range of positive outcomes including lower levels of depression, stress and anxiety
Chiauzzi E, Brevard J, Thum C, Decembrele S, Lord S, 2008 August, MyStudentBody-Stress: an online stress management intervention for college students	US	Three armed randomized control trial, college students at 6 U.S. colleges (n=240)	Participation in interventions , scores on the Perceived Stress Scale	MyStudentBody–Stress (online stress management intervention) participants were more likely to increase weekly physical activity, use specific stress management methods, and exhibit decreased anxiety and family problems

Ebert DD, Lehr D, Smit F, Zarski AC, Riper H, Heber E, Cuijpers P, Berking M, 2014 January - August, Efficacy and cost-effectiveness of minimal guided and unguided internet-based mobile supported stress-management in employees with occupational stress: a three-armed randomised controlled trial	Germany	Three armed randomized control trial (n = 408), 6 month duration	Participation in interventions , scores on the Perceived Stress Scale	effective low-threshold interventions are needed that are accessible for as many people as possible
Heber E, Ebert DD, Lehr D, Cuijpers P, Berking M, Nobis S, Riper H, 2017 February, The benefit of web- and computer-based interventions for stress: a systematic review and meta-analysis.	Germany	Meta-analysis with 26 comparisons (n = 4226), RCT's with participants >18 years from 1990 - May 2016 (articles)	Randomized control trials	Web- and computer-based stress-management interventions can be effective in reducing stress, depression, and anxiety and maintain those effects for up to 6 months. Second, interventions using TWC and CBT interventions as a theoretical basis proved moderately effective in reducing stress. Third, short and medium interventions (up to 8 weeks) are more effective than long interventions (9 weeks and longer). Fourth, guided

				interventions yielded a greater effect size for reduction of stress than unguided interventions.
Fleischmann RJ, Harrer M, Zarski AC, Baumeister H, Lehr D, Ebert DD, 2018 June, Patients' experiences in a guided Internet- and app-based stress intervention for college students: a qualitative study.	Germany	Two-armed randomized control trial, 150 participants (≥ 18 yrs, German speaking university students), 3 month duration. (sessions were 1 hour and interview was 45 minutes)	Semi-structured interviews	Expressed the need for more individualization, more content-related support, more background information, better understanding of their situation. Session length and frequency of reminder constitute the feeling of overwhelmedness caused by treatment.
Cavanagh K, Strauss C, Cicconi F, Griffiths N, Wyper A, Jones F, 2013 September, A randomised controlled trial of a brief online mindfulness-based intervention.	UK	Online two armed randomized control trial, 155 students, 2 week duration	Participation in interventions , scores on measures of mindfulness, perceived stress, perseverative thinking and anxiety/depression symptoms	Participants in the intervention had significant improvement in mindfulness skills, perceived stress and anxiety/depression symptoms.
Frazier P, Meredith L, Greer C, Paulsen JA, Howard K, Dietz LR, Qin K,	US	Two-armed randomized control trial, 257 students, 3 week duration	Participation in interventions , self-report measures of	Intervention group reported increased control and decreased perceived stress, stress symptoms, depression and anxiety.

2014 December 22, Randomized controlled trial evaluating the effectiveness of a web-based stress management program among community college students			perceived stress, stress symptoms, depression, and anxiety	
Rai D, Lin CW, Ierlan MT, 2016, The Influence of Scheduling Style on Assortment Size	US	Survey, n=82 Amazon mechanical Turk participants. Study 2 - manipulating instead of measuring scheduling styles, survey, n = 69 Mturk, 56% female, mean age = 41	Participation in a survey	Scheduling style influences consumers' assortment size preferences, clock timers focus on feasibility preferring small assortments, and event timers focus on desirability considerations preferring large assortments.
Mark E, 2013 July - August, - Gamification, A Tool for Effective Patient Retention	UK	n/a	Qualitative description	Gamification is the natural add-in as it helps build a framework around reminder/ calendar functionality
Vogel, J.J., Vogel, D.S., Cannon-Bowers, J., Bowers, C.A., Muse, K. and Wright, M, (2006 April), 'Computer	US	Meta-analysis	Academic studies	Males show no preference while females show preference for the game and interactive simulation programs - when controlled by teachers there was no advantage. When dictated by a computer there was

gaming and interactive simulations for learning: a meta-analysis'				preference for the traditional teaching method.
Schaaf, R. (2012). 'Does digital game-based learning improve student time-on-task behavior and engagement in comparison to alternative instructional strategies?'	US	Randomized control trial, elementary school students age 8-10	Student observations and attitudinal surveys	7/8 trials produced higher student table observations averages for DGBL, and 6/8 trials showed higher student survey average in level of enjoyment while experiencing DGBL.
2000 August, Stop procrastination now!	US	n/a	Qualitative description	Do the worst task first, "you'll be in a better state of mind to complete the rest". Take 10- a few minutes is enough to get yourself into the flow of a project. Plan ahead. Break it down (smaller steps).
Hen M, Goroshit M, 2020, The effects of decisional and academic procrastination on students' feelings toward academic procrastination	Israel	Survey, 373 undergraduate social sciences students	Participation in a survey, scores on Decisional Procrastination Questionnaire and Academic Procrastination Scale - Student	decisional procrastinators experience discomfort associated with procrastination, academic procrastinators want to change their procrastination habits but do not report feelings of discomfort

			Form	
Alsawaier RS, 2018 January 2, The Effect of Gamification on Motivation and Engagement	US	Literature review	Academic studies	More research needs to be done
Newton C, 2016 August 31, Sunrise is dead, and so is the dream of an excellent calendar app	US	n/a	Qualitative description	Calendar apps face challenges that prevent them from improving. Type in nearly any combination of who you're meeting with, and when, and where, and Fantastical turns it into a calendar entry. calendar should be tactical, finding me time for my stated priorities. It should offer analytics on the time I spend on meetings, and with whom, and follow up with me on any action items.
Díaz-Morales JF, Ferrari JR, Cohen JR, 2008 July, Indecision and avoidant procrastination: The role of morningness-eveningness and time perspective in chronic delay lifestyles	Spain	Survey, 509 adults mean age = 49.78	Participation in three psychometric scales	Avoidant procrastination related to low future time orientation and low morningness, whereas indecision related to both (a) high negative and high positive past orientations and (b) low present-hedonistic and low future time orientations
2016 May 18,	UK	n/a	Qualitative	Users are able to specify

Shift Calendar app			description	what type of shift they work and on what days by tapping on calendar dates. They are then given an option of day or night to choose. There are even options to add notes on each day.
Streif JD, 2013 March, Questions to Ask before Using Mobile Devices and Mobile Applications for Business	n/a	n/a	n/a	n/a
2014 November 20, Aroga Technologies Updates on Vizzeco & LB Systems Research Inc. Partnership and Global Google Reseller Rights	n/a	n/a	n/a	n/a