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Human nature has always been playful. It is then of no surprise that since the earliest recordings of human civilisation, human beings have enjoyed playing games in some shape or form (Fuchs, 2012). Gamification defined as "the use of game design elements in non-game contexts" (Deterding et al., 2011, p. 8) can serve as a natural bridge between the existing innate nature of play and repurposing it for specific utilitarian purposes (Deterding, 2012).

Gamification revolves around a complex interaction between physical, psychological and social domains. These domains can be understood to be driven by intrinsic motivation (Deci and Ryan, 2010) to satisfy needs (Richter et al., 2015). The mechanics of gamification can be divided into 3 sequential themes: motivational affordances, psychological outcomes and behavioural outcomes (Hamari et al., 2014). This takes from earlier psychological works of Ajzen (1985) and the 'Theory of planned behaviour'. Gamification thus takes advantage of established psychological habitual mechanisms to achieve behavioural change.

Tailoring motivational affordances or 'gamification tactics' to the task is the key to successful gamification (Deterding, 2012). Goal-setting is a proven and effective tool for enhancing self-motivation (Zimmerman et al., 1992). Challenges incite the 'wanting to do it oneself' psychology that is present from childhood and integral to an individual's concept of self (Geppert and Küster, 1983, p. 355). Education and health behaviour literature provides ample evidence for the value of feedback and offering indicators of performance level in enhancing their learning, performance and their rate of adaptation. It is worth noting that individuals proactively seek participation, something that gamified experiences theoretically automate. (Crommelinck and Anseel, 2013; Eisingerich, Auh, and Merlo, 2014).

Introducing competitive elements, such as through leaderboards and disclosing the identity of the 'leaders' is prevalent throughout society, providing motivation for others to strive for a similar level of achievement. However, caution is advised by Sun et al. (2015) when understanding its effects. Against popular thinking, first place does not always equal highest satisfaction, and leaderboards can prove to have negative and unintended effects overall on the motivation and attainable progress of participants (Hanus and Fox, 2015). Finally, narrative is beginning to gain traction as a way of affecting behaviours in more applied contexts, such as in autism. Sansosti and Powell-Smith (2006) suggest that social stories were able elicit social behaviour in autistic children. The evidence behind the maintenance of these behaviours nonetheless, is inconclusive (Sansosti and Powell-Smith, 2006). The most popular tactics use multiple strategies, including participation, for maximum impact and effectiveness on psychological and behavioural outcomes (Deterding, 2012; Merlo, Eisingerich, and Auh, 2014).

It is necessary to highlight that the behavioural change effects of these tactics are in many cases directly linked to the communication of 'achievement'. Designing an appropriate and effective 'signifier' for achievement is a valuable consideration (Hamari and Eranti, 2011). Variations of these principles exist, and must be modified in accordance to the implementation environment to achieve optimum desired effect (Oprescu et al., 2014). An example of using this principle would be modifying health-related behaviours, as opposed to behaviours in the workplace (Miller et al., 2014).

Gamification elements act as motivational affordances to enhance intrinsic motivation, leading to different psychological states (Hamari et al., 2014; Sherwani et al., 2015). In turn, these outcomes may drive behaviour change. Gamification can be understood as a method of enhancing certain psychologies and behaviours (Ahmed, et al., 2015; Amir and Ralph, 2014). A few psychological heuristics are particularly worthy of note and have wide-reaching implications, and will now be explored.

Gamification is not a fundamentally new concept, but with the advent of digital multimedia and resulting virtual worlds, there has been a surge in multidisciplinary interest in

its short-term and longer-term applications (Seaborn and Fels, 2015). From keeping journalism relevant (Gangadharbatla and Davis, 2016) to medical disease management (Cafazzo et al., 2012), gamification is seen as the solution to the unique challenges brought about by the 21st Century.

Gamification in its current form has been employed most extensively in digital media. Digital platforms such as eBay, Facebook and Uber have unlocked the power of gamification through network effects and this trend is only set to continue (Van Alstyne et al., 2016). By subtly using the core principles of visual enticement, badges, reward points and social encouragement, these services provide a utilitarian function, whilst satisfying hedonic and social needs (Hamari and Koivisto, 2015; Park, Eisingerich, Pol, and Park, 2013; Park, Eisingerich, and Pol, 2014). Whilst there has been exploration of the hedonic elements of gamification beyond points, badges and leaderboards (Shovman, 2014), the utilitarian application of gamification is less well recognised. The balance between hedonic and utilitarian function based on the nature of gamification is one that is worthy of careful consideration (Valkonen et al., 2015). The utilitarian and hedonic user motives affects individual solution innovation to problems (Stock et al., 2015). Taken in the context of gamification supporting hedonic elements in concrete fashion, understanding specific utilitarian requirements on a broad scale could help wider society take better advantage of gamified tools (Hamari and Koivisto, 2015). Further exploration in gamification's role in utilitarian functions, such as enhancing workplace efficiency, is required (Hamari, 2013).

Chou (2015) argues that the implementation of gamification largely takes two forms. Explicit gamification is the use of games to advance non-game purposes, for example FoldIt, an online multiplayer game that assists protein modelling for cancer and HIV (Stannett et al., 2016). Implicit gamification is commonly cited in literature, and involves using game elements, such as the eBay seller badge system, in non-game contexts. Research is trending towards the usage of explicit gamification in the traditional realms of education, training, health, workplace productivity and niche areas, such as tourism (Stadler and Bilgram, 2016). Searching for gamification on Google Scholar nets 17,300 results from 2000 to 2016. 15,300 of these results are dated from 2011 onwards. There has been a considerable rise in interest in the study of gamification in the academic community.

Weight management

Weight management is becoming an increasingly prevalent problem, both in the overweight and underweight category (Caballero, 2007). Currently, 62% of adults are overweight or obese, and the 'trend is still upwards' (Public Health England, 2016b). The UK is considered to be the 'fat man of Europe' and obesity is the "biggest public health crisis facing the UK today" (NHS Choices, 2015). On the other end of the spectrum, more than 725,000 people in the UK have an eating disorder, and this figure is likely to be an underestimate as there are many in the community who do not seek help (Beating Eating Disorders, 2016). Whilst prevalence is difficult to estimate, the number of hospital admissions for an eating disorder has increased by 8%, highlighting the growing problem of more extreme weights and the need for more effective weight management (Health & Social Care information Centre, 2014). Both eating disorders and being overweight are risk factors for a number of illnesses, and can reduce the average life expectancy by up to 10 years, and reduce the quality of life even further (NHS Choices, 2014). Despite governmental efforts in public policy and healthcare provision, obesity management suffers from a lack of coherent national public policies arguably as a result of fragmentation of care and a lack of knowledge of what successful treatment entails (Barth and O'Kane, 2016).

Despite worldwide public policy efforts to maintain average weight within the population in ideal ranges, the health and economic complications of obesity continues to financially overextend the health and welfare system in the UK (Brauner et al., 2013). Direct costs attributed to obesity are estimated by McKinsey to be £6 billion per annum (Consultancy.uk, 2015): 5% of the entire NHS budget (Health, 2011), as compared to less than half a billion in 1998 (Public Health England, 2016a). There are also costs, attributed to sickness and reduced productivity due to weight problems, to the wider economy, estimated to be in the region of £27 billion (Public Health England, 2016a). Both of the current costs are set to double by 2050, and if the trends continue, it will cripple the already cash-strapped NHS (Health, 2011). One of the problems with lifestyle obesity interventions involving behaviour is the high levels of relapse (Teixeira et al., 2015). Social media such as Twitter and Facebook have been used to help with weight management (Nambisan, 2015). The usage intends to utilise social support to sustain any behaviour change. There has been a shift of focus from treatment to prevention (Hardeman et al., 2000). The effectiveness of this is debatable. This is one area that gamification could intervene. Smartphone apps such as MyFitnessPal could be useful for those who are already motivated to change their weight, but introducing the app is unlikely to produce substantial weight change for most patients (Laing et al., 2014). This highlights the need and focus to incorporate gamified elements to fill this gap.

Potential for gamification in weight management

Gamification is increasingly used as a design strategy (King et al., 2013) when developing behaviour change support systems in the healthcare domain (Alahäivälä and Oinas-Kukkonen, 2016). Digital applications already collect large amounts of data about each player (Yannakakis, 2012). This can be analysed to gamify and personalise weight management. Studies have shown that aspects of gamification can be twice as effective compared to a standard paper diary (Turner-McGrievy et al., 2013). Applications that incorporate behaviour change techniques tend to be associated with increased intervention effectiveness (Direito et al., 2014).

Since 2010, the NHS has had its budget effectively frozen, increasing by just enough to cover inflation (King's Fund, 2015). Gamification could be a step in not only tackling medical problems (Cafazzo et al., 2012), but also potentially saving the NHS money. By tackling the problem in a gamified way (Deterding, 2012), it encourages users to take an active interest in their health and how they respond to issues that occur. Initial investment in an application could cost more than $1,000,000 (USD) (Yarmosh, 2015), and when confidentiality and maintenance are accounted for, this figure is likely to rise significantly. With the rise of the millennials and their new ways of thinking, they are changing the landscape and challenging ingrained norms (Howe and Strauss, 2000). The approach to weight management has changed dramatically over the last couple of decades, changing faster than ever before, with two thirds of the world now having access to a mobile phone (Free et al., 2010). Gamification of weight management could be the natural and logical next step.

Gamification in public health policy

The application of behavioural economics to health policy has gained interest from the research community and from multiple governmental entities, including those in the US (Economist, 2012) and the UK (Trujillo et al., 2014). Behavioural economics is the study of psychological, social cognitive and affective factors of individuals on their economic

decisions (Smith, 2016). It follows the philosophy that individuals should not be forced to act in a certain way, but rather informed, encouraged or 'nudged' to change their bad habits (Bell and Eisingerich, 2007; Voyer, 2015), which has been of interest to policy making (Wheelock et al., 2012). Trujillo et al. (2014) present the five main concepts of behavioural economics (hypertrophic discounting, social bias, confirmation bias, reference bias and loss aversion) and support the use of these concepts to encourage healthy habits. Implementation strategies utilise behavioural economics principles such as periodic reminders and small and frequent rewards to promote habit formation.

The Behavioural Insights Team (BIT), part of the UK government and Cabinet Office, aim to make public services more cost-effective by introducing more realistic models of human behaviour, empowering people to make "better choices for themselves" (The Behavioural Insights Team, 2016). Drawing on behavioural science and behavioural economics, they presented new ways to achieve the coalition government's commitments at the time (Behavioural Insights Team, 2010). The *No Excuse Needed* campaign, developed by the Behavioural Insights Team in Melbourne, Australia successfully prompted behaviour change and reflection on the local drinking culture. They used humour and surprise to argue that "you don't need an excuse to say that you've had enough to drink" achieving significant behavioural changes in more than one third of the population targeted leveraging the principles of behavioural economics (Halpern, 2016). The BIT advocate the use of behavioural prompts, periodic reminders and frequent rewards that are in line with underlying motivations of the targeted population, encouraging the change of social norms around healthier behaviours. Reservations exist, advising caution as to the equity and ethics in the use of such incentives in a large population (Trujillo et al., 2014).

Public health policy gives advice concerning healthy eating habits and exercise, yet there is a lack of a rigorous evidence base to support the results of this type of policy. Boylan et al. (2012) found that knowledge of public health guidelines did not equal comprehension. More importantly, they highlighted the need to tailor guidelines to individuals, using smartphones and therefore gamification, as an appropriate tool for personalisation to support adherence (Boylan et al., 2012). Currently, medical recommendations for exercise is 60 minutes per day (Trumbo et al., 2002), yet the literature has not yet identified cost-effective methods to ensure long-term adherence (Macfarlane and Thomas, 2010). Gamification through mHealth shows promising results in enhancing adherence to treatment, for example in the case of diabetes monitoring (Theng et al., 2015). To maximise adherence to public health policy, the important question of targeting the correct populations, collaboration (Bell and Eisingerich, 2007), perhaps leveraging the power of gamification tactics as motivational prompts, is posed to policy makers and is a future area of research (Dolan et al., 2010).

Current pitfalls

Based on the current literature on the topic, we note that the common causes for failed gamification projects include:

- An emphasis on extrinsic motivators (e.g. badges, points, virtual currencies), without including intrinsic motivators (e.g. belonging, curiosity, learning)
- A lack of consideration to the players' motivations (e.g. fun motivators like role playing, organizing, status and achievements, mastery of skills and learning)
- The introduction of competition (e.g. leaderboards) in an environment where collaboration, creativity or learning is necessary.

Indeed, Hamari and Koivisto (2013) suggest that gamification has proven itself in 'hedonic contexts', whereas evidence for its use in 'utilitarian contexts' is still in its infancy. Despite the great promise of the potential of mHealth and gamification in public health policy, as seen throughout the review of the existing literature, there remains important gaps in substantial evidence in the form of clinical trials to enable and ensure its correct use in tackling exercise and weight management promotion (Kamel Boulos et al., 2014). This research aims to assess the extent to which gamification can be utilised and tailored to facilitate behavioural change, exploring its potential in public health policy. Despite an increasing body of research on demographic differences, psychological characteristics and the potential of gamification, there is a void in practical knowledge about the use of gamification within utilitarian contexts, particularly within healthcare. In addition, with the ever increasing multi-faceted implications of the increasing burden of obesity, along with the current budgetary concerns in the UK, cost-effective initiatives for behavioural change are required. There is a current lack of empirical evidence supporting existing public health policy and their methods to achieve behavioural change (Boylan et al., 2012). We aim to identify how gamification can support the developing trends in new frameworks of behavioural change implementation. Our findings may then be used to provide recommendations for policymakers as to the potential benefits of gamifying the implementation of public health initiatives and how this should be executed. Furthermore, we aim to provide direction for further study in this rapidly developing and promising area of research.

Methods

In order to comprehensively address the aims of the study, a mixed methods approach was utilised, combining qualitative and quantitative research methods in order to gain an in-depth understanding of the research area and provide insightful analysis. The adoption of triangulation allowed us "to map out, or explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint" (Cohen et al., 2000; Ren, Tsai, and Eisingerich, 2016; Tsai and Eisingerich, 2010). Initially, gathering qualitative data was the focus through interviews with smartphone application end-users, in addition to expert views on gamification and public policy. A survey was then created to enable quantitative analysis. Combining the two research approaches reduced the likelihood of bias that may be introduced with just one method (Cohen et al., 2000).

Qualitative research was used to capture subjective opinions, allowing detailed exploration into the views of participants regarding gamification and weight management, and the reasons behind their attitudes and behaviours. This involved identifying and understanding their behaviour, by observing and engaging them in the process (Cresswell, 2009). Semi-structured interviews best elicited these views, allowing the researchers to probe into new and relevant ideas proposed by participants (Edwards and Holland, 2013).

An inductive approach was used to condense data, establish associations and patterns, and generate a "framework of the underlying structure of experiences" in the raw data (Thomas, 2006). This approach allowed for examination of attitudinal and behavioural patterns of participants to generate new theory regarding behaviour change and weight management. The traditional deductive approach was not appropriate for this field which is relatively non-established (Morse, 1991).

End-user interviews aimed to establish the motives behind using digital applications, drivers in behaviour change and the reasons for maintaining a healthy weight and exercising. Questions regarded applications as they serve as a proxy for the implementation of

gamification tactics. Information from these interviews enabled us to identify principles of gamification that improves motivation for behaviour change.

To increase credibility, interviews were conducted until redundancy of information was achieved. At this saturation point, no new insights were obtained and no additional themes could be identified. Therefore, these data categories are well established and validated (Bowen, 2008).

Our experts were chosen based on their previous work in public policy, gamification or behaviour change in healthcare. The purpose of expert interviews was to establish the presence and feasibility of incorporating gamification into public policy, and how public policy can drive behaviour change in the general population. Their knowledge and understanding of the field allowed them to identify pertinent opportunities and barriers for gamification in public policy, informing us of any shortcomings in the past that is not in the public domain. Our experts' valued insights provided us with a deeper understanding of public policy.

A cross-sectional approach was taken, where participant data was collected at a specific moment in time without manipulating their environment (Institute for Work and Health, 2015). This allowed us to gain a more thorough insight into the views of participants, especially within our time and financial constraints.

We recognise that a cross-sectional design will not be able to fully establish the effects of gamification on behaviour change over time (Goldberg et al., 2013; Ren, Eisingerich, and Tsai 2015), therefore we have also included interview questions that relate to past experiences to form attitude-behavioural links. Written consent was obtained from all participants, and ethical approval was not required.

Due to limited time and resource available, a purposive convenience sampling method was used in the selection of potential end-users in the qualitative arm of the study (Kelley et al., 2003). Interviews were held with peers and relatives between the ages of 18 and 60, due to ease of access and their willingness to partake in the study. To partake in the study, end-users were required to be smartphone users or have previous experience with smartphone applications. All interviews were conducted in English.

Similar to that of the end-users, both convenience and purposive sampling methods were utilised to devise a shortlist of potential experts that could be contacted via email. Potential experts within the fields of gamification, health policy, behavioural change and healthcare management were initially contacted. Four experts were receptive to our invitations, with a variety of backgrounds.

Semi-structured interviews were conducted as they permitted a certain degree of flexibility, allowing exploration of varying personal opinions and views regarding behavioural change (Edwards and Holland, 2013). Performing interviews in settings comfortable for participants also aided the researchers to build rapport and trust with the participant, increasing credibility and encouraging openness, especially when recalling past gamification-related experiences. Whilst this method was time-consuming and limits sample size, it was our preferred approach.

Two initial sets of questions were devised in order to allow for the exploration of areas of interest pertaining to the aims of the study. This consisted of 27 potential questions to end-users and 27 questions to experts in the field. As a group, the questions to end-users were reviewed and condensed to 11 core questions. To experts, an official definition of gamification from the literature was introduced, followed by 12 questions refined using Kvale's nine types of questions (Kvale, 1996). Follow-up and probing questions were of particular importance as they allowed the researchers to explore interesting topics as they arose in the interview, without compromising on the structure provided by the core questions (Edwards and Holland, 2013).

The questions formulated for end-users were included in 14 initial interviews carried out by the author team (two interviews per researcher), within a time period of two weeks. They served as an initial test, allowing the researchers to determine if the wording of the questions was appropriate, ensuring that no practical problems would arise (Teijlingen and Hundley, 2001). Researchers were able to identify questions deemed ambiguous or complex by participants, which could later be adjusted or discarded. The test also determined the average length of an interview, to act as a guide for future reference (Peat, 2002). Additionally, researchers used this to gauge if the main topics were being sufficiently explored. A revised set of these questions were used in 14 more interviews of end-users carried out by all of the researchers.

Face-to-face interviewing enabled the researcher to more accurately assess genuine initial responses to gamification concepts (Ritchie and Lewis, 2003). This was taken into account during analysis regarding data inferences. All 28 end-user interviews were conducted face-to-face. Expert interviews were held in person, via telephone or through FaceTime, due to the experts' varying accessibility. To facilitate the transcription process, all interviews were recorded using researchers' smartphone. Prior to recording, the researchers gained consent to record the interview in the signed consent form.

Each researcher transcribed his/her interview. Following this, all seven group members read through each of the 32 interviews once, taking brief notes of initial ideas, followed by a discussion of the overall findings as a group. This ensured that all researchers were familiar with the raw data obtained. As Boyantzis states, a code is "the most basic segment, or element, of the raw data or information that can be assessed in a meaningful way regarding the phenomenon" (Boyatzis, 1998). Three researchers re-read all of the interviews as a group, ensuring that each interview was read by at least two members. During this process, the researchers indexed all initial codes that could be identified alongside their frequency of appearance using Microsoft Excel 2016. 14 primary sub-themes were identified; collections of codes which were related to each other. Codes were discussed as a group and classified under the sub-themes that had been identified. The initial list of sub-themes was condensed to three higher themes which were deemed most relevant to the aims of the study. Using NVivo v11 data analysis software, all interviews were re-read again, coding additional data related to the devised sub-themes that may have been missed. The software allowed the researchers to see all quotes grouped under each code, as well as the specific themes and sub-themes that they belonged to. The higher themes were revised and analysed thoroughly in relation to the overall aims of the study. Sub-themes were identified, breaking down higher themes into manageable and meaningful parts, enabling the researchers to give the analysis structure. Themes and powerful quotes supporting them were presented in a table, allowing for a highly visual demonstration of the results. Irrelevant codes were excluded from results. The results helped to map the complex inter-relationships between gamification and behaviour change, presented in qualitative analysis.

28 participants were interviewed. Characteristics of participants are summarised in Table 1 below. All interviewed participants owned smartphones.

Table 1: End-user interview participant characteristics

Characteristics	**(n)**	**%**
Age		
Mean	27	
Range	18-60	
Gender		
Male	(17/28)	60.7%

Female	(11/28)	39.3%
Occupation		
Student	(18/28)	64.3%
Employed	(6/28)	21.4%
Unemployed	(4/28)	14.3%
Ethnicity		
White/White British/White European	(15/28)	53.6%
East Asian	(5/28)	17.8%
Black Caribbean	(4/28)	14.3%
Mixed	(1/28)	3.6%
	(3/28)	10.7%

A total of 28 end-user interviews were conducted. Participants broadly discussed topics regarding their motives for using smartphone applications, their drivers in behaviour change and their reasons for maintaining a healthy lifestyle. Three primary themes that influenced health behaviour regarding health and fitness were identified as:

1. Application usage
2. Motivation
3. Barriers and Limitations

Our findings have been summarised into a thematic diagram (Figure 1) and key quotes have been highlighted in a tabular format.

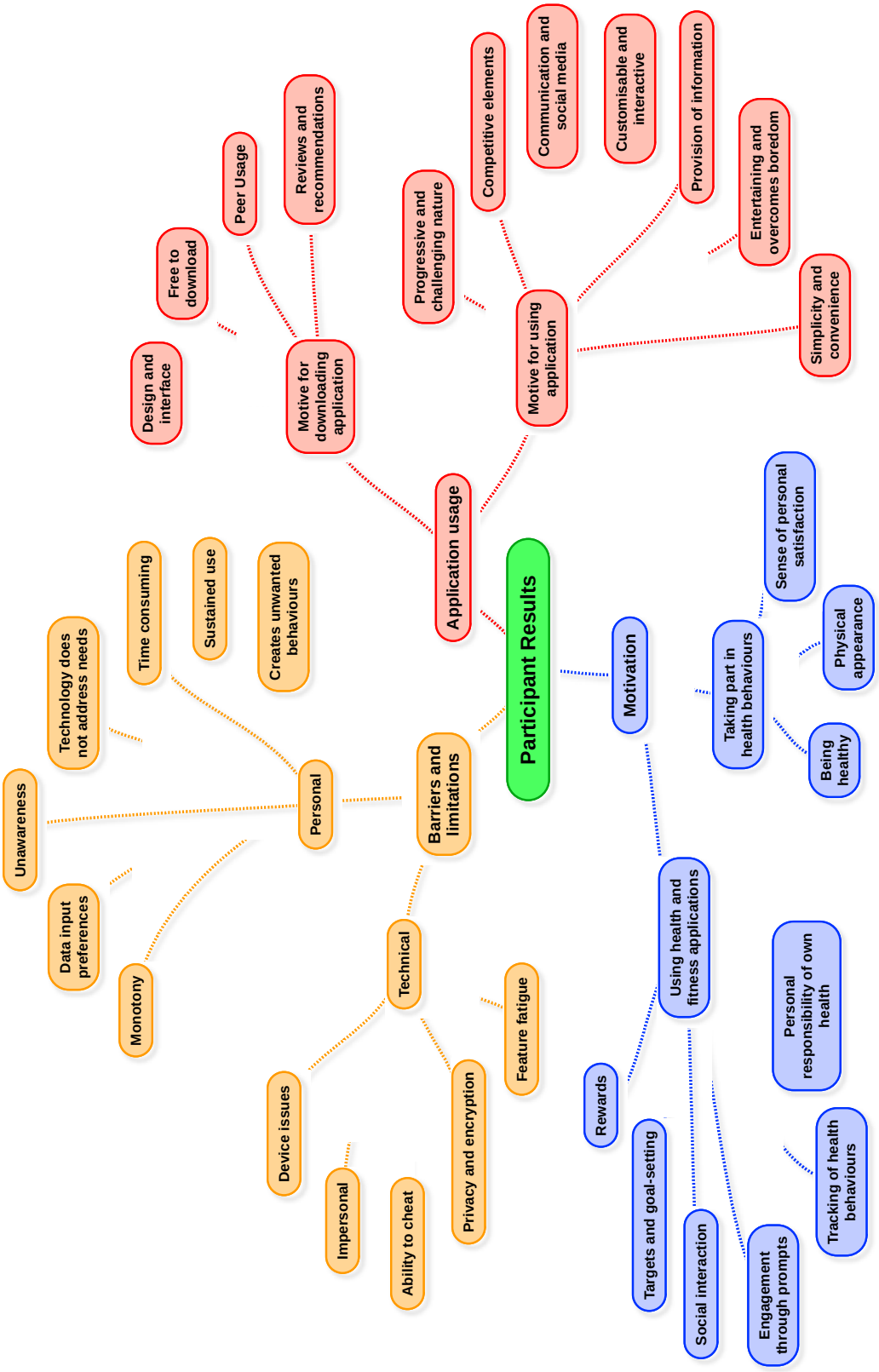

Figure 1: Diagrammatic representation of themes identified from end-user interviews

Themes

A common theme that influenced the behaviour of participants using digital applications were the perceived benefits and features of the application. Prolonged and repeated use were dependent on the ability of these features to engage participants. The two sub-themes that were identified under application usage were: motives for downloading an application and motives for using applications.

Motivations for downloading application (Table 2)

Motives for initial download consist of the application's ability to gain the attention of end users and the current level of interest within the participant's circle. This firstly consists of the design and interface of the application that attracts participants to notice the application (P02 P07). The price of the application is an important factor and it is free applications that particularly encourage the initial download (P08 P19). Generally, popularity of the application and peer usage reassures end-users of the application's credibility and leads to download (P19 P20). Additionally, participants valued the opinion of friends and family; reviews and recommendations were a strong influence on application download (P03 P09).

Table 2: Codes and quotes related to 'Motivations for downloading application', from end-user interviews

Codes	Quotes	Participant
Design and interface	*"It's very colourful, It's very vibrant, there's lot of sounds"*	P02
	"It helps if they have a catchy look. If something has a catchy name and a catchy look I am more tempted to download it"	P07
Free to download	*"Also if it's free, then I'm willing to try it out"*	P08
	"If the app is free, then I will pretty much follow through the recommendation all the time because you've got nothing to lose.	P19
Peer usage	*They were both popular when they came out. Lots of friends and colleagues were all playing them. They were both free. Everyone was using it at the moment.*	P19
	I think peer usage is essential. If your friends don't use it, or aren't interested in it. Then it's very difficult – what's the point of using a social network site when your friends don't use it? You have no-one to talk too.	P20
Reviews and recommendations	*The reason why I did it was because I go to a celebrity column website, and one of the columnists is a fitness trainer and she really recommended it*	P03
	My friends told me it was very good and I gave it a try.	P09

Motivations for using applications (Table 3)

The prolonged use of applications is associated with a number of features that the participants deem important. The majority of participants use digital applications to communicate with others and for social media purposes, a key factor related to application usage (P01 P14). A common feature that kept participants using applications was the simplicity and convenience provided. This included the design of the user interface, the problem solved, the time saved, and how user-friendly it was (P07 P11). The customisation of the application to the participant's needs also featured (P05 P17) and participants valued the application's ability to be interactive and personal.

Applications were also used when participants found its content or concept entertaining. Some even noted the addictive nature of an application kept drawing them back. In many situations, applications were used to overcome boredom and pass time (P03 P06). In other cases, applications were able to provide information that was important to participants, and some applications were comprehensive with multiple features leading to ease of use and time saved (P02 P08).

Key gamification elements including the ability to progress through levels, increasing difficulty and challenging nature of applications were mentioned frequently in many interviews. These were found to enable the application to capture the attention of participants and encourages repeated and prolonged use (P02 P08 P14 P17 P21). Competing with friends and peers was also a recurring element. The ability to beat others' high score and compete in real time was desired by participants as it added a fun, competitive element to the application (P06 P07).

Table 3: Codes and quotes related to 'Motivations for using applications', from end-user interviews

Codes	Quotes	Participant
Communication and social media	*Mainly you can just talk to people at any time or send them a message*	P01
	I like to stay in touch with people. Social media is just convenient on the phone rather than on a laptop.	P06
	I think the main one is stay interconnected with everybody, which is made just so easy through all those apps.	P14
Simplicity and convenience	*the simple the better. I don't like spending a lot of time searching through pages on pages of the app to find what I'm looking for.*	P07
	Well, usually it makes everyday life easier and helps answer questions whenever and wherever you are.	P11
Customisable and interactive	*what was useful was that it remembered meals that you had often or a combination of the foods that you would use. And you could put in your own foods as well*	P05
	Yoga studio! I use it a lot. It's a really good app because I can customise my own yoga workouts.	P17
Entertaining and overcomes boredom	*It's new and interesting so you get to see something new every half an hour, and it keeps you connected to other people*	P03

	When you're really bored and you just need something to keep your mind going, pass the time, kill some time, they're good.	P06
Provision of information	*I think because now apps give you a lot of information, and apps are multifunctional and you won't download 5 apps that will tell you different things. You'll just download one app that will tell you everything*	P02
	Quick access to information. And to have that information with me in all places at all times.	P08
Progressive and challenging nature	*Each level gets harder and harder and the challenge increases and it makes you want to achieve more*	P02
	It's just about beating the game really. I want to complete the levels that they have	P08
	I like the way it progressed, at very nice pace. It wasn't too difficult from one level to the next. It had a very nice progression. And getting more difficult was very cool, challenging	P14
	It's addictive to keep collecting chests and moving up the game. Even when I'm not very good.	P17
	Well, Sudoku is quite intellectually stimulating so you have levels of difficulty. At the minute I'm on extreme expert mode so its nice to be able to work your way up from easy to expert	P21
Competitive elements	*if you're playing and your friends are playing as well you get competitive, you try and beat their scores*	P06
	I was the first one to get that game, and then 4 of my friends got it, so it became a bit of a competition for a while	P07

Motivation

An overarching theme that was discussed was the reason for an end user to participate in health and fitness behaviours. Two distinct sub-themes emerged: motives for engaging in health behaviours and motives for using health and fitness applications.

Motivations for engaging in health behaviours (Table 4)

The findings for this sub-theme logically split into three different aspects. The first main reason for engaging in health behaviours was the sense of personal satisfaction and feeling of fulfilment that accompanied exercising and/or eating well. The majority of participants experienced an internal drive to partake in healthy behaviours, resulting in happiness (P05 P11 P21). Participants also reported that feeling and being healthy was a key aspect of their motive to exercise and many understood the long term benefits of healthy behaviours (P08 P22). The other factor that drove participants to engage with their health was their desire to improve their physical appearance (P07 P23 P25).

Table 4: Codes and quotes related to 'Motivations for engaging in health behaviours', from end-user interviews

Codes	Quotes	Participant
Sense of personal satisfaction	*I like to feel good about myself, I know I feel bad and I don't function as well when I eat things or when I don't exercise. I enjoy it, I enjoy exercise, and taking care of myself, its important.*	P05
	Because I feel that when I'm active and when I move I'm more alert and happier. It makes me feel good. And that's what motivates me because I feel good when I do it	P11
	So having, that sort of feel good factor is sort of the main reason why you use these apps to lose weight, or whatever you use it for, its to know that you're working towards your goal. It all comes down to inner well being at the end of the day.	P21
Being healthy	*I want to be healthy. I just want to live a healthy life, because it is better for me.*	P08
	Yes, it's good to keep fit and as I age I need to keep fitter because it causes me knee pain, tiredness if I don't keep up with that. So if I am to avoid any chronic diseases like diabetes, heart conditions, that's why I need to be more fit.	P22
Physical appearance	*I know I look better, feel better and even work better if I am in better shape*	P07
	Oh I want to look good for summer	P23
	I think it is the confidence that comes with that I suppose…and looking more aesthetically appealing.	P25

Motivations for using health and fitness applications (Table 5)

Participants had a variety of motives for using health and fitness applications, and there were certain features of these applications that encouraged healthy behaviours. An important aspect that recurred in many interviews was that health and fitness applications enabled participants to take personal responsibility for their own health. Applications increased awareness and helped participants to direct their behaviours to better achieve their health and fitness aims. (P03 P22). Applications that engage participants with their health and fitness whilst having a social aspect to it were welcomed by participants. This competitive element offered encouragement to sustain health and fitness behaviours whilst keeping participants engaged (P10 P23). Participants also expressed that applications can maintain engagement and that reminders were useful in helping participants to uphold their commitment to health behaviour (P03 P24).

Aspects of gamification were identified from the interviews. Applications that offered targets and goal-setting (P24 P28) were welcomed by participants as it motivated health and fitness behaviour. Additionally, the use of rewards, including social, digital, and financial rewards were found to be particularly useful in encouraging participants to achieve their health and fitness objectives (P03 P07). Participants also discussed the benefits of being able to monitor their progress as they go along to track their health and fitness (P10 P27).

Table 5: Codes and quotes related to 'Motivations for using health and fitness applications', from end-user interviews

Codes	Quotes	Participant
Personal responsibility of own health	*It's for my binge eating problem, logging and making you personally responsible for what you're eating, and establishing patterns in your eating and what's not ordinary behaviour for you.*	P03
	It helps me to keep count of my steps and that in turn, helps me to feel yes I have done something. So it helps me to motivate to do more.	P22
Social interaction	*a lot of people at the company said that it helped them find someone else to do sports with... People joined and became running pairs/ buddies, even though they didn't really run but just because of this competition app they started doing activities.*	P07
	I think it's the idea of being able to try and compete with yourself or your friends to do better that encourages you to carry on towards those goals and we start and say – 'lets start and go for a run every week'	P10
Engagement through prompts	*An app might be better because it keeps you engaged daily, whereas a doctor you can't see daily.*	P03
	Maybe if I don't know, I got reminders everyday, something just to tell me what to do, and give me a bit more order about what I'm doing.	P24
Targets and	*Well I think especially with couch to 5k, because it has a*	P24

goal-setting	*goal at the end of it, it makes me really want to hit that goal. Because I've started, I might as well finish it*	
	If you have some sort of goal, if you want to burn x-amount of something. You obviously need some sort of goal in your life – on some level, then you can use these apps to slowly achieve it. You can see your progress.	P28
Rewards	*If you get given a reward, you're probably more likely to exercise as long as the novelty doesn't wear off*	P03
	For some people a reward system might work well as well. Turning it in to a game, saying if you run X km in a week then you go up a level, or reach some kind of rank. I know for some people that would work quite well.	P07
Tracking health behaviours	*it tracks where you go and gives you little targets and goals that you can work towards – which help to motivate you to actually go and do stuff.*	P10
	Oh they are very useful; in fact, I have one app for running. It records, every time I go for a run, it records the length, the speed, and when I look back, say for example the past year – I know how much exercise I have done.	P27

Barriers (Table 6)

A predominant theme that arose was the perceived limitations and barriers to the use of health and fitness applications. Two sub-themes were identified: personal barriers and technical Barriers

Personal barriers consist of innate factors that result in participants not wanting to use health and fitness applications. A number of participants expressed concern that health and fitness apps can create unwanted behaviours and attitudes whereby people obsess over results in a detrimental way (P03 P11). Some participants also stated that they would prefer not to input data, either because they were embarrassed by the results or because the information was time-consuming and difficult to obtain (P04 P26). There are also participants who prefer not to use technology to help them with their health and fitness objectives. This was due to a number of reasons such as participants preferring to track of their health and fitness themselves, the impersonality of applications and the lack of expertise an application provides in comparison to a fitness trainer or doctor (P01 P09).

Another barrier involved was maintaining the behaviour, as a number of participants conveyed that the use of health and fitness applications is often only for the short term (P08 P21). Additionally, participants found that applications that suggest the same repetitive exercise routine can be monotonous and lead to boredom (P10 P21). The amount of time that applications consumed was another issue that prevented continued use (P13 P15), and some participants were simply unaware of the applications that are currently available for health and fitness (P01 P06).

Table 6: Codes and quotes related to 'Theme 3 – Personal Barriers', from end-user interviews

Codes	**Quotes**	**Participant**

Creates unwanted behaviours	*I could go on for essays on the explosion of weight loss apps and tie that into the need for something everyone to be eating clean, and healthy and in which we create a very, very screwed-up relationship with food*	P03
	it makes you a little bit of a control freak – because in some apps you put in how much you eat, what you are going to eat, how many calories you've been eating today, how much you've been running – you know just like totally focused on how much you move, how much you eat and everything – you just get obsessed.	P11
Data input preferences	*There are also times when I eat a lot during the day, like a cheat day, and I would be too ashamed of the food I have eaten to actually put it in the app, which skews the results.*	P04
	but I needed to input a lot of information to make use of it. Some of the information was difficult to obtain for myself. So I ended up stopping using it.	P26
Technology does not address needs	*I just keep track of things myself really. Personally I wouldn't need to log it.*	P01
	I don't see a point for an app like that. An app is not going to teach me how to play hockey or how to sail, or how to run or how to cycle in the gym, so I don't really need it.	P09
Sustained Use	*that's my fear also for the apps. They have it, they do it, its cool, they do it for three months, and then… Will they keep up with it?*	P08
	I'll be honest, the last time I used that was about 3 or 4 months ago. I go through phases where I'll be really into it for a couple of weeks and then I'll stop using it	P21
Monotony	*It kind of just got a little bit repetitive and samey.*	P10
	I don't know, just bored. And I wanted to try something different. So obviously that has a set of exercises that are very good in their own right no doubt about it, from my point of view, I like to change so I go from doing those exercises to some weights exercises.	P21
Time consuming	*I think its quite time consuming and I've not found them helpful so far. That's probably why I've stopped using them.*	P13
	I think this is probably the thing that prevents me the most – is the impression that this would take a lot of time to keep tabs on the results and actually make use of them.	P15

Unawareness	*I don't really know which ones are out there to be honest. I don't know any names.*	P01
	Yeah, I don't really know of many good ones to be honest. Unless I'm just blanking at the moment. I cant think of any that I've used.	P06

Technical Barriers (Table 7)

A major technical barrier was the limited scope of health and fitness applications whereby the application did not suit certain diets or health conditions (P03 P08). Concern about the ability to manipulate results was also expressed. The reliance on user input was expressed as a limitation (P04 P21).

Participants felt certain applications offered too many features that confused them or took up too much of their time, leading to feature fatigue (P14 P15). Additionally, some participants expressed concern regarding privacy and data encryption and not wanting to input personal information (P08 P16). Problems with their mobile device including battery, memory and screen problems also arose (P01 P25).

Table 7: Codes and quotes related to 'Theme 3 – Technical Barriers', from end-user interviews

Codes	**Quotes**	**Participant**
Impersonal	*a lot of these apps don't really cater for non-white diets*	P03
	I think its quite hard to get one size to fit all, particularly in exercise. So I didn't really like what they had on there, so I haven't used it since.	P06
Ability to cheat	*I would keep using it if I wouldn't be able to cheat on*	P04
	It can obviously the way its entered by yourself, it relies on the user so it has potential there to cheat and things like that.	P21
Feature Fatigue	*that one is too difficult, it has too many features. Maybe I'm just stupid. It has so many things you have to go through. And then having to select all the ones that are important to you, I just don't have time for that.*	P14
	What has stopped me is probably the complexity of keeping tabs on what you do. The whole thing looks a bit too complex for the use that I get.	P15
Privacy and encryption	*What sometimes stops me from downloading an app is that I'm not always sure if it's safe. I cannot always oversee if it is safe, so I'm hesitant to try it out.*	P08
	don't want to spend too much time, giving my data and all my levels. It's a bit personal.	P16
Device issues	*I didn't have enough storage, that's the main reason why I didn't download them.*	P01

	Partly because my phone is such a poor quality phone, it's a S3 Mini – it is really outdated and it also dies, the battery is poor – so I don't use it.	P25

Expert Interviews

A total of four expert interviews were conducted. Semi-structured interviews were used to discuss the concept of gamification and its feasibility in public health policy. Our findings have been summarised into a thematic diagram (Figure 2) and key quotes have been highlighted in a tabular format.

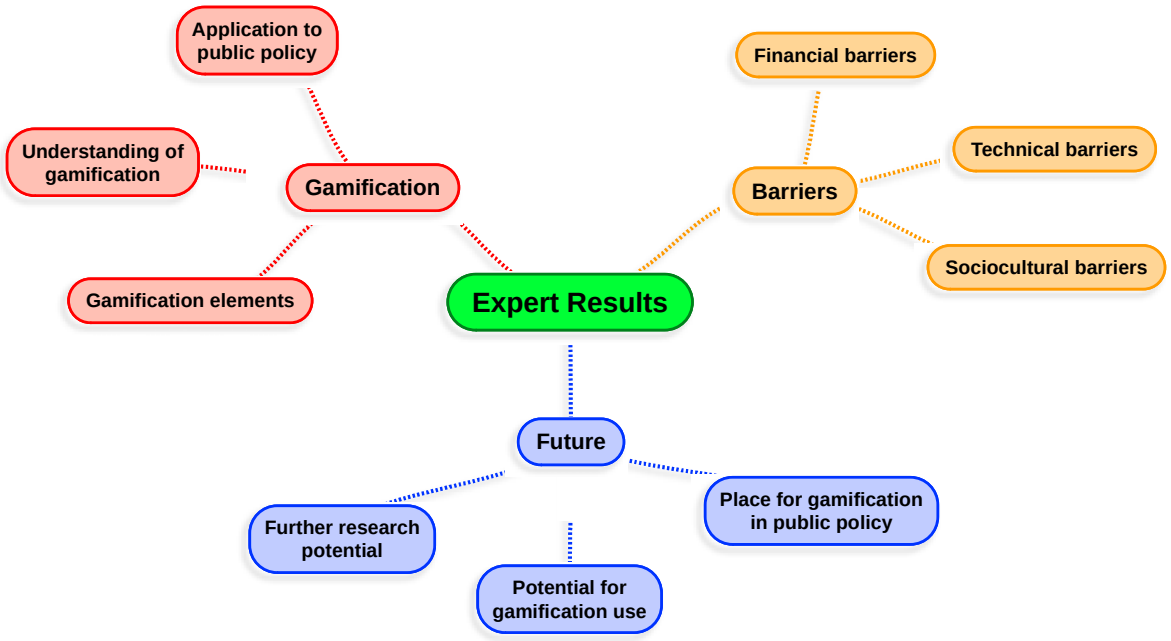

Figure 2: Diagrammatic representation of themes identified from expert interviews

A number of concerns regarding the feasibility of a gamified initiative through public policy arose and these were encompassed into a higher theme titled 'Barriers.' This was divided into firstly technical barriers which included concerns regarding digital development, maintenance, inequalities and regulatory issues (E01 E02 E03 E04). Sociocultural barriers related to the practicality of changing both public and health professional behaviour using gamification. Issues such as inertia and unwillingness to change (E01 E02). Another important aspect of barriers included the expectation of financial hurdles that may need to be overcome before gamification could be introduced. Experts noted concern regarding whom the responsibility of payment falls upon and the need to collaborate with private entities to bring digital gamification to the market (E01 E02). See Table 8 for codes and representative quotes.

Table 8: Codes and quotes related to 'Theme 2 - Barriers', from expert interviews

Coding	Quotes	Expert
Technical barriers	*There are some high-level regulatory issues relating to the shipping of personal data, particularly across geographical locations, especially in cloud data*	E01
	The other thing is that one-shot interventions risk tipping people into yo-yo situations where they succeed then they fail	E01
	This is a practical issue so time-limited interventions may not work, and games may not work, and then there is the question of boredom.	E01
	We know that mobile adoption is not universal, we know that there is an issue of platform fragmentation	E01
	But it is very difficult to scale analogue technologies	E02
	Enabling – so a good example for enabling I would say is, there is no point implementing interventions, gamified or not, to get people to say wash their hands in hospitals if the alcohol gel dispensers are empty	E02
	I don't think there is a one size fit or answer to any of these, otherwise someone would have found it.	E03
	But also as with all of these innovations, the potential for use to go down one alley and diverting resources away from well-tried and tested methodologies also. There should be caution.	E03
	So it is outmoded quite quickly which is the problem.	E03
	the whole point – a lot of this kind of stuff you don't want to ever be depriving or disadvantaging people who already the most deprived	E04
Sociocultural barriers	*people can self-initiate their behaviours but there is usually an element of professional support at least at some point*	E01
	Clinicians can basically ill initiatives through inertia and there is	E01

	a piece around enabling environments, about helping the professional side and the people who will drive this in terms of public health advisors to understand the benefits, limitations, how you promote that once people get that on their device	
	The starting boat irrespective of those, is people's lives are more than their health. Their health is only a small part of their existence	E01
	But also the emotional issue, because you're dealing with people who have failed in the past.	E01
	the technique that works for one demographic group may not be appropriate for another	E01
	The inertia, the latency and the failure to really understand the technology issues at a deep level	E01
	These things are quite 'faddish', they work for a few weeks, a few months.	E02
	I think activity and calorie counting is probably a very good place – although I think it's a stubborn behaviour to change.	E02
Financial barriers	*The funding landscape is something you let the market figure out for itself*	E01
	There is a related, could be an ethical concern or practical concern, about coupling financial stakes and the risk of failure to a health-related behaviour, bearing in mind health inequality, that people who most need this kid of support is the people who are least able to afford to pay	E01
	I think in terms of who pays for the apps themselves, there's some nuance to the question.	E01
	I do have a problem that the people who are most at need have to pay for these things, but then we don't have a huge amount of money	E01
	Do I think government has any ability to challenge these guys? Not really. They just don't have as deep pockets and interest. They are not going to spend two years developing a gamification platform that every kid wants to play because they don't have the resources and talent to do that	E02

Throughout the interviews, experts repeatedly eluded to the future potential of gamification, thus creating a higher theme about the future. Experts communicated their hesitation regarding gamification and the need for future research before public resources can be expended (E01 E02 E03). The potential for gamification use, regarding its scope and use

to encourage health behaviours and interest in mHealth, was also discussed (E01, E02). More specifically, the place of gamification in public policy was considered. Creating a context receptive to gamification and supplementing current health practices were examples of topics that were communicated (E01, E02, E04). See Table 9 for codes and representative quotes.

Table 9: Codes and quotes related to 'Theme 3 - Future', from expert interviews

Coding	Quotes	Expert
Further research potential	*one of the biggest challenges and uncertainties in terms of research evidence. Is whether you can sustain behaviours that may need to be done over a lifetime.*	E01
	some people might not say that each one of them is gamification so it's hard to say if gamification is good or successful for public policy	E02
	Because I guess it is a bit early yet to be able to look at long-term longitudinal studies	E03
	I would want to see a clear evidence base that this methodology works better than others before I spend some health service money.	E03
Potential for gamification use	*Only a superficial amount has been tapped into so far, especially in the apps I have seen.*	E01
	there may be a role of policy to create and resource places or settings where evaluations can take place which bring together interesting developers and clinicians with people interested in behavioural change to make that happen	E01
	the policy interest is in mHealth generally, and the idea that this is a scalable platform for interventional delivery. People use their mobile phones all the time, so there is a possibility that this can be used for interventional delivery	E01
	I would say get these games makers who are accused of encouraging violent behaviour with all sorts of things like Grand Theft Auto, or whatever, why don't we encourage these guys to do something a bit better?	E02
	I think we're very close to being at a point where perhaps we'll do automatic calorie counting.	E02
	I think activity and calorie counting is probably a very good place – although I think it's a stubborn behaviour to change.	E02
	maybe an immersive app is much more likely with plus gamification elements – is much more likely to sustainably change your behaviour	E02

Place for gamification in public policy	*there is a policy drive towards the adoption of mobiles and tech for self-care, but the jury is out to how that might be achieved. It is an interesting technique*	E01
	I think there is a role for policymakers to create an enabling context for this kind of work to be done	E01
	If it was shown to be the case that behaviour change and gamification techniques can be effective then there is a role for policymakers through funding, through commissioning to ensure that those things are promoted.	E01
	So there is a place at policy level about the enabling environment to help that happen, particularly technical expertise and supporting the sharing of practice or more structural interventions around digital innovation	E01
	Where this is relevant and where there is a role of policy, is helping people recognise the problems of governance and security is health apps and managing health-related data.	E01
	I think they can, you know, they can support gamification interventions by putting the resources there and opening things up.	E02
	Have you looked at children in classrooms? Because that's really where I would have thought gamification - Isn't that what the whole education system is about?	E03
	I think it is an added benefit to be used as an adjunct. I think it could be a very cost effective way of helping people make better decisions. I think it should be used as an adjunct to other ways of policy making like regulations and things like that.	E04
	I think that there is a future in gamification as an adjunct in health policy. There some health policy methods that you can't get away from. But I think it's a very useful adjunct that may in the right context have a much more significant effect at a lower cost than other regulatory methods.	E04
	I think there's certainly a role. There's probably a huge role in habit behaviours like exercise and diet and smoking, where gamification and regular feedback as a result of the gamification can help you track your progress.	E04

Survey

A survey was created with the aim of gaining further, quantifiable insights into the areas of gamification, smartphone usage and public health policy behaviours. This stage of research was concerned with assessing the differences between population groups and to highlight any potential demographic variations in preferences to gamification. There were three main objectives for the survey:

1) Quantify smartphone usage, both general and with regards to health/fitness apps
2) Assess effects of gamification tactics on behaviour
3) Quantify knowledge of and adherence to public health policies

These objectives were addressed through online dissemination of an 18 question survey, created using Qualtrics Insight Platform. The survey was divided into five sections. Basic demographics were collected to allow for comparison between demographic groups during analysis. Age, gender, ethnicity and basic education level completed were requested. Smartphone ownership and general monthly usage was collected, followed by general usage of health and fitness applications. Depending on responses to the latter, respondents were asked to indicate how often they use such apps, why they stopped using them, or why they have never used them. Although this matter does not address gamification topics directly, reasons for application usage may provide valuable information regarding the interaction of people with digital technologies and give an insight into the potential for gamification in the future.

10 core principals of gamification were identified from relevant literature (Cugelman, 2013 ; Hamari et al., 2014). These principals have been studied in depth previously in the context of motivational affordances and their relation to gamification (Hamari et al., 2014). Statements eliciting these principals in non-game contexts (Deterding et al., 2011) were created by the researchers.

Adherence to various public policies was assessed by analysing health behaviour. This was followed by questioning knowledge of specific public health policies. This order of questions aimed to reduce the risk of recall bias. This topic was included to establish any potential differences in demographics to the knowledge and adherence to health policies.

Most questions were in the multiple choice format, allowing either single or multiple answers. Three questions allowed for free text answers. One set of questions utilised a Likert scale to quantify agreeableness to statements regarding tactics of gamification. It was decided to provide the options of “strongly agree”, “agree”, “disagree” and “strongly disagree”, purposefully leaving out the option “neutral”. The reasoning for this was to incentivise respondents to formulate an honest opinion for each statement, and minimize social desirability bias which arises from respondents not wishing to give an answer that may be socially undesirable (Garland, 1991).

Distribution was electronic, primarily via social media (such as Facebook), and by email. No incentives were provided to complete the survey: participation was entirely voluntary. The survey link was posted on social media on seven different occasions, and remained open for a period of 21 days. At this stage, no selection criteria were applied when distributing the survey, all responses were considered. An introductory screen before the survey was included to inform participants of the aim of the project and that their responses would be anonymous.

Results

322 individuals started the survey. 244 participants completed all questions. However, all data, even from incomplete surveys, was used for analysis. Reasoning for this is that all

questions from the survey were independent from another and individual data from each question is valuable to addressing the research aims.

Of 322 participants, 258 (80%) were aged 18 – 24 and 26 (8%) aged 45 – 54. 188 (59%) were male, 133 (41%) female. The most prevalent ethnic group was White (220, 69%), followed by Asian (76, 24%). 147 participants (46%) had completed up to the level of secondary education, and 115 (36%) held a bachelor's degree or equivalent. Basic demographics of survey respondents is shown in Table 10.

Table 10: Basic demographics of survey respondents

Characteristic	***n***	***%***
Age (years)		
< 18	5	2%
18 - 24	258	80%
25 - 34	11	3%
35 - 44	10	3%
45 - 54	26	8%
55 - 64	9	3%
65 +	3	1%
Gender		
Male	188	59%
Female	133	41%
Ethnicity		
White	220	69%
Multiple ethnic groups	17	5%
Asian	76	24%
Black/African/Caribbean	5	2%
Other ethnic group	2	1%
Highest education completed		
Secondary (High School) Education	147	46%
Apprenticeship	4	1%
Bachelor's Degree or equivalent	115	36%
Master's Degree or equivalent	48	15%
None of the above	8	2%

306 of 311 respondents (98%) claimed ownership of a smartphone. 245 (79%) indicated that the total number of days spent without using their smartphone in the past month to be 0 days. In other words, these individuals used their smartphone every single day. 49 (16%) responded they had gone 1-2 days without a smartphone, 7 (2%) went 3-4 days and 11 (4%) 5 days or more. There was no significant difference in usage between males and females or between age groups (p = n.s). This si shown in Figure 3.

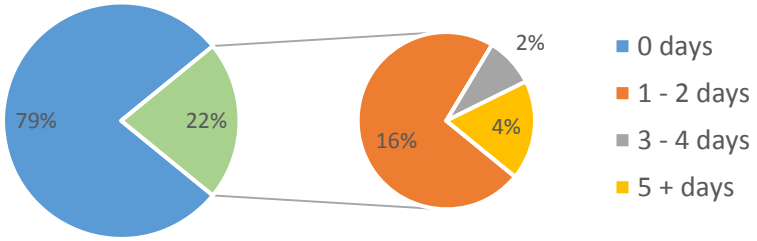

Figure 3: Full days per month that smartphones are not used, as percentages of total smartphone owners

Table 11 shows common categories of smartphone application usage ranked by prevalence. Communication was the most prevalent purpose of usage for smartphones with 303 participants (97%) indicating to use it for this purpose. Other common uses were Social Media (91%) and Photos (87%). Categories for which smartphones were used least were Medical (17%), Books (19%) and Health & Wellbeing (31%).

Table 11: Categories of smartphone application usage, ranked by prevalence

Category	n	*%*	*Rank*
Communication	303	97%	1
Social media	282	91%	2
Photos	270	87%	3
Organising (alarms, calendar, lists)	269	86%	4
News	247	79%	5
Music	231	74%	6
Travel	190	61%	7
Finance	139	45%	8
Education	130	42%	9
Games	123	40%	10
Health and Wellbeing	96	31%	11
Books	58	19%	12
Medical	52	17%	13
Other	19	6%	14

A significant result amongst the 'other' category to mention is Podcasts, mentioned by 5 of 19 respondents (26%) who selected this category. Males indicated a significantly lower usage of "Health and Wellbeing" applications than females ($p = 0.025$), but greater usage of finance applications and games ($p = 0.007$ and $p = 0.010$ respectively). Significantly higher usage of social media, educational applications and games was noted in groups aged <35 compared to those ≥35 ($p = 0.06$, $p = 0.004$ and $p = 0.001$ respectively.

110 individuals (35%) said they currently used a health or fitness app, 82 (26%) indicated to having used a health or fitness application but terminated their usage, and 118 individuals (38%) indicated not to have ever used a health or fitness application. There was no significant difference in these rates between males and females or between those aged <35 and ≥35. Of those who stated that they currently use a health or fitness application, 16 (15%) used the application more than once a day, 14 (13%) used it once a day, but a majority of 58 (53%) use it a couple of times a week. This is visually represented in Figure 4.

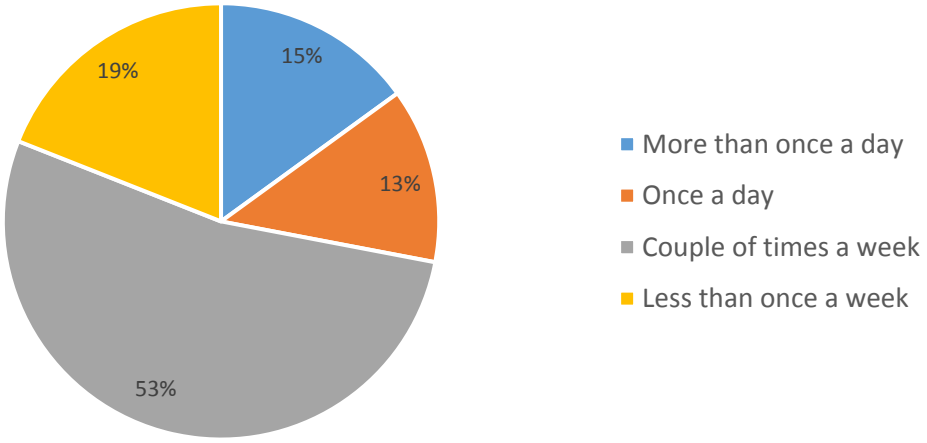

Figure 4: Usage of health or fitness application per week as a percentage of total current users of the same category

41% of respondents who stopped using a health or fitness application indicated 'too much effort required for use' to be a reason to stop using a health or fitness app, identifying it as the most common reason to cease application usage. This was followed by time consumption (32%). Cost was the least cited reason, with only 3% indicating this as a factor. Again, no differences were noted between males and females. Differences were not assessed between age groups due to the sample size being too small (n<10). See Figure 5 for more details.

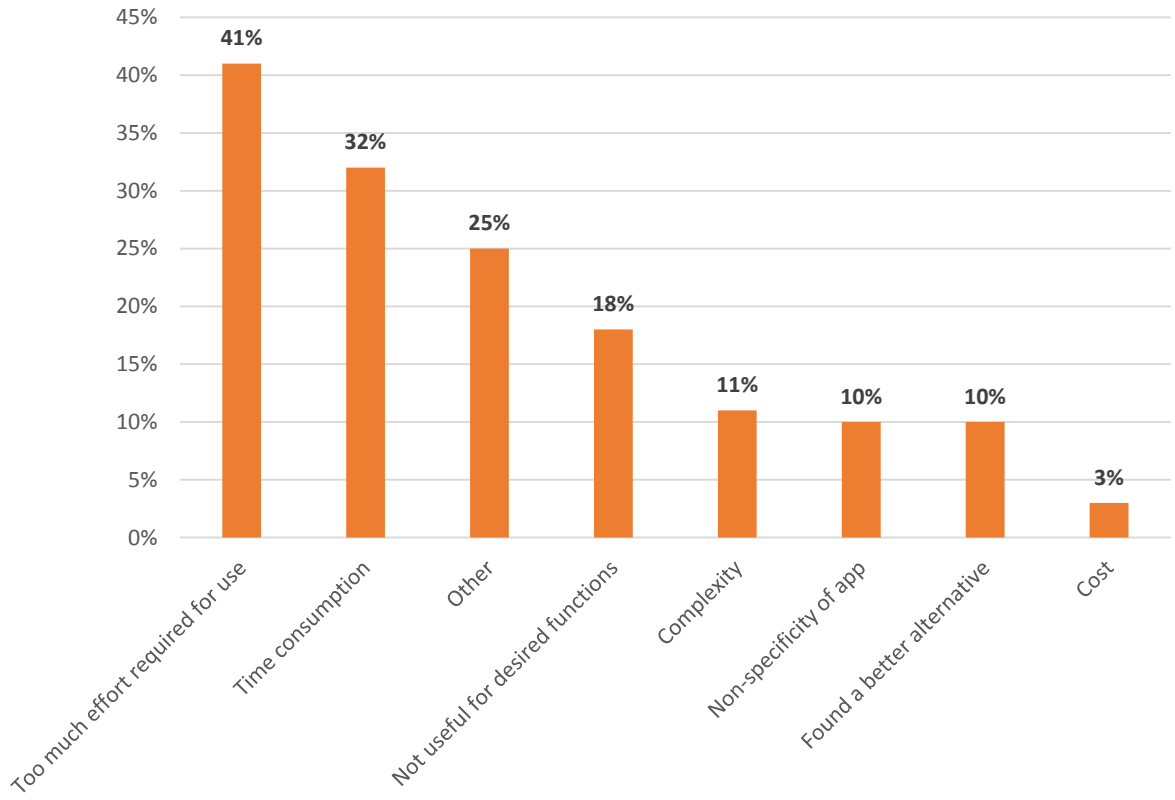

Figure 5: Reasons for ceasing health & fitness application usage, ranked by prevalence

Those who had never used a health or fitness app were asked a follow-up question to identify why they didn't use such apps. This identified that apps are deemed 'not useful for desired functions' as the most common reason, with 36 respondents (34%) indicating this as a reason. The least common reason was cost, which was identified by 8 respondents (7%). No differences in these reasons were noted between males and females, however those aged <35 appeared to be slightly more concerned about cost than those aged ≥35 ($p=0.016$). See Figure 6 for more details.

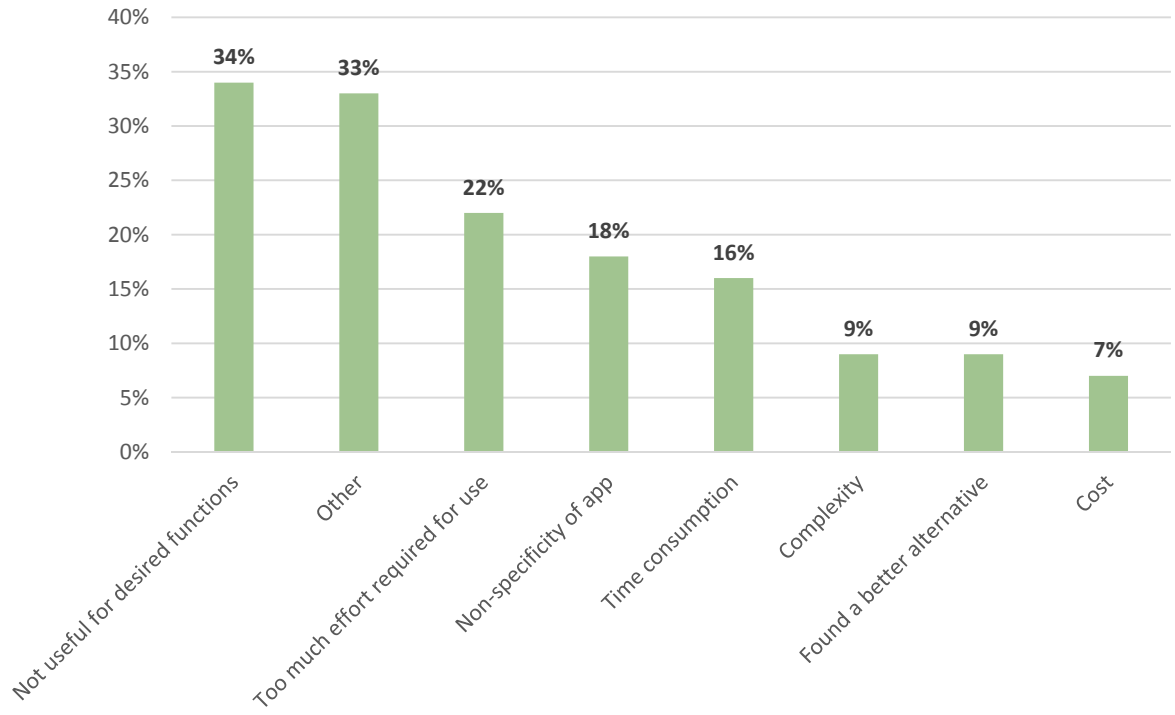

Figure 6: Reasons for never using health & fitness application usage, ranked by prevalence

266 respondents agreed with most of the statements relating to key gamification tactics (defined as mean > 2.5 – see Statistical Analysis). The only tactic that tended towards disagreement was 'Rewards' with a mean of 2.41, however this value was not significantly different to the median ($p = 0.101$). The most agreeable tactic was 'Progress' with a mean of 3.5. For a full list of gamification tactics tested, see Table 12.

Table 12: Extent of agreement to gamification tactics of all respondents. P-values indicate probability that indicated value differs from cut-off value of 2.5.

Gamification Tactic	***Mean (all)***	***p-value***
Points	2.82	< 0.001
Leaderboard	2.87	< 0.001
Badges	3.25	< 0.001
Levels	3.02	< 0.001
Goals	2.92	< 0.001
Challenge	3.37	< 0.001
Progress	3.50	< 0.001
Rewards	2.41	0.089
Stories	2.92	< 0.001
Feedback	3.15	< 0.001

When analysing differences between males and females, three gamification tactics were found to differ significantly in agreeableness. Females tended to agree more with statements regarding points ($p = 0.002$) and goals ($p = 0.047$), whereas males tended to agree more with levels ($p = 0.025$). This is shown in Table 13.

Table 13: Extent of agreement to gamification tactics for males and females

Gamification Tactic	*Mean (Males)*	*Mean (Females)*	*p-value*
Points	2.67	3.03	.002
Leaderboard	2.90	2.82	.433
Badges	3.21	3.32	.244
Levels	3.10	2.89	.047
Goals	2.82	3.06	.025
Challenge	3.38	3.35	.653
Progress	3.49	3.52	.653
Rewards	2.32	2.54	.050
Stories	2.85	3.04	.053
Feedback	3.16	3.13	.624

Table 14 shows the extent of agreement to gamification for both females and males. Analysis of differences between sample population aged under 35 and those aged 35 and over identified significant differences in four gamification tactics. Younger respondents tended to agree more with leaderboards ($p=0.004$), badges ($p=0.001$) and levels ($p=0.004$), whilst older respondents agreed more with stories ($p=0.006$).

Table 14: Extent of agreement to gamification tactics for age groups <35 and ≥35

Gamification Tactic	*Mean (< 35)*	*Mean (≥35)*	*p-value*
Points	2.82	2.83	.913
Leaderboard	2.94	2.44	.004
Badges	3.33	2.78	.001
Levels	3.09	2.56	.004
Goals	2.92	2.92	.976
Challenge	3.39	3.22	.146
Progress	3.53	3.34	.112
Rewards	2.44	2.19	.126
Stories	2.88	3.19	.006
Feedback	3.16	3.08	.469

Discussion

This research explored various areas of gamification and specific gamification tactics. Qualitative interviews elicited responses highlighting the presence of gamification in established digital platforms and applications. Quantitative data tested preferences for particular gamification tactics as described by Cugelman (2013) and how they relate to characteristics and preferences of respondents. Our findings inform how gamification affects behaviour and motivation of individuals, as well as differences in the preferences for gamification tactics according to demographic characteristics.

End-users in qualitative interviews frequently mentioned or alluded to specific elements of gamification that have affected their motivation, and therefore behaviour.

Social interaction

A prominent theme that was elicited during end-user interviews was the importance of social interaction in initiating particular behaviours. This encompassed multiple areas such as downloading an application to be able to communicate with others (P19 P20), using a particular application (P01 P06 P14), and engaging in specific health behaviours (P07 P10). Quantitative data supported the importance of social factors in application usage, as communication and social media were the two most common uses of smartphones. The responses received from respondents appeared to indicate that social interactions and peer involvement were particularly important in initiating a particular behaviour, but also had a key role in maintenance. This highlights the importance of the incorporation of social elements into gamification tactics to optimise the desired behavioural change effects they are being used to enforce (Shi et al., 2014).

While exploring the types of social interaction, competition is mentioned specifically by many end-users as a reason for maintaining a certain behaviour (P06 P07) and receive rewards through self-satisfaction and recognition when they perform better. Peers can also view users' progress thus making their commitment to the behaviour change public, providing an effective extrinsic motivator as users want to avoid public embarrassment when they fail to successfully change their behaviour (P10), known as the 'Principle of Social Proof' (Cialdini, 2001).These findings all suggest that social interaction, through competition with others, or public commitment to goals, increase individuals' tendencies to participate in certain activities or behaviours.

Goal-setting

Setting targets and goals, and being able to track progress towards achieving that goal, was a topic explored by various participants of end-user interviews. Goals enforce a sense of commitment, resulting in increased engagement with the activity (P24 P28). This highlights that certain behaviours can be, and are, self-initiated by self-motivating factors, as highlighted by one of our expert-interviewers. However, this expert also mentioned that an element of professional support is required (E01). Our qualitative findings suggest that goal setting and progress tracking as elements of gamified applications may provide a component of this support, encouraging and intrinsically motivating individuals to adhere to a new healthy behaviour (P03 P22).

Rewards

When questioning participants of our end-user interviews about their motivations for participating in health behaviours, the most frequent results related to various rewards they receive from physical activity and healthy nutrition. Tangible rewards included an improved physical appearance and benefits associated with that (P07 P23 P25), whilst intangible rewards concerned personal satisfaction and "feeling good about [oneself]" (P05 P11 P21). It is noteworthy that none of these rewards are external motivators, but instead internal rewards that originate from an increased sense of self. Combined with the finding that 'rewards' was the only gamification tactic identified by quantitative data analysis as not to receive general acceptance, it can be hypothesised that external rewards are not effective in affecting behaviour. Instead it would appear that an individual enjoys internal rewards in the form of satisfaction when they participate in a behaviour that achieves a goal they wish to reach. This is supported by literature which emphasises that external rewards may in fact decrease long-term internal motivation (Nicholson, 2012 ; Ryan, 2001). Hence, when using gamification

techniques, caution should be exercised when attempting to reward certain behaviours, and it would be preferable to use alternative methods to increase internal motivation instead.

Progress and levels

The concepts of progress and advancement through levels were recognised to motivate behaviour change by many end-users (P02 P08 P17). The importance of these concepts was supported by quantitative data as progress was highlighted as the most preferable gamification tactic and levels followed in fifth place (Cugelman, 2013). The effect of progressing through particular levels evokes a sense of achievement, and allows for visualisation of competence, a key factor of the self-determination theory (Ryan and Deci, 2000). This in turn increases internal motivation to progress further, hence increasing adherence to and involvement in a particular behaviour. Increases in difficulty of levels was also mentioned as a "stimulating" feature (P14 P21), highlighting the significance of flow theory to keep users engaged in the particular activity (Csikszentmihalyi, 1990).

Feedback

Feedback allows for real-time interaction between the gamified application and the user, giving a degree of customizability and personalization (P05 P17). Receiving feedback from an application serves a similar purpose to receiving recognition for achieving goals or meeting targets (P11) and appears in literature as a strong motivating factor (Herzberg et al., 2011; Liu et al., 2015). It is interesting to note that participants appear to be comfortable with information and communication originating from digital applications, which is significant, as it may highlight that gamification of applications promotes transfer of communication between the virtual and analogue world.

Gamification and demographics

Throughout various end-user interviews a focus arose on the importance of customisability of applications as a necessary feature to optimise satisfaction from use (P05 P17). The quantitative survey highlights that the most common reason for not using a health or fitness application was that they were perceived as 'not useful for desired functions'. These findings emphasise that all individuals have differing needs, and hence application features, such as gamification tactics, should be adapted to best suit an individual's needs and preferences.

Our research suggests there is a relationship between an individual's basic characteristics and their susceptibility to gamification tactics. Quantitative research analysis highlighted that certain tactics such as leaderboards were preferred by males compared to females, whilst conversely females preferred points and goals tactics. Similarly, differences were noted between age groups as well. These findings suggest that gamification tactics are not equally effective on all members of a population, and there may be a vast scope of variables which affect how individuals respond to gamified techniques. This highlights the potential of personalised gamification, in which certain tactics are emphasised over others based on a user's basic characteristics, personality and preferences to have optimal effects on internal motivation and behavioural change. During end-user interviews, different gamification tactics were identified as themes relating to motivation for using an application or doing exercise. Despite not being asked directly about any gamification tactics, different factors were mentioned spontaneously by participants, presumably based on their own preferences and ease-of-recall. The variation in tactics that the individuals mentioned

contributes to the view that gamification tactics affect people differently based on personal characteristics and preferences, and hence this should be considered when designing platforms that include such tactics. This was also highlighted during expert interviews (E03) who mentioned that the use of gamification in public policy could not be seen as a 'one size fit all' solution to public health issues. E04 expanded on this concept by discussing that the type of gamification required in certain policies would require tailoring depending on cohorts and age groups being targeted.

Regression analyses explored a new relationship, previously unaddressed in literature, in which the agreement to various gamification tactics were related to usage of various app categories. Correlations between some tactics and increased usage of games, health and wellbeing or medical apps suggest that individuals' tendencies to be affected by certain tactics also affect their usage of certain application categories. This may be due to a higher presence of corresponding tactics in those specific types of applications currently. However, it may also suggest that individuals' susceptibility to gamification tactics is linked to their preference of application usage. For example, our research suggests that someone who is more prone to agree to the statement that "knowing how [they] perform in comparison to others is important" to them, is more likely to use games on their smartphone. Based on the assumption that the statement was accurately designed to reflect the concept of leaderboards through this statement, this would then suggest that an individual's tendency to be affected by the gamified feature of leaderboards is correlated to their usage of games on their smartphone. Particularly noteworthy is that data showed that males are more likely:

a) to agree to leaderboards than females and
b) to use games on their smartphones than females.

This shows that the demographic preference for a gamification tactic, and that tactics' correlation with a particular application usage, corresponds with the demographics overall preference for application usage. This suggests that preference for gamification may be a mediator for a particular preference of application category (James and Brett, 1984).

Although the sample size for the quantitative data for this study is relatively small, particularly for this type of social research (Kotrlik and Higgins, 2001), these aligned findings indicate a potentially interesting relationship that should be explored further.

Contribution to theory

The power of gamification lies in the level of interactivity

Our research suggests that an individually tailored gamified experience that allows for real-time interaction is most effective in regards to behaviour change. This is in keeping with the current trends, where the assumption that games and reality are separate worlds of interaction is continuously challenged (Walz and Deterding, 2015). Indeed, though modern technologies and virtual reality technologies, the distinction between the world experienced through gamification and actual reality will continue to blur. Drawing a parallel between the consumption of literature, say a novel, through the written word, and through a game, there is an increasing preference for interactivity to enhance user trust (Eisingerich and Bell, 2008; Ryan, 2001). Gamification provides interactivity through short and regular feedback loops (Deterding, 2012). Feedback is highlighted as a key requirement for successful gamification in our research. There is a new mentality emerging, where gamification is the norm and has a symbiotic relationship with reality. This is a version of the future that could be realistically expected (Volkova, 2013).

Novel gamification is not a novelty

A readiness to accept novel gamification applications was an overarching theme elicited from our research. This willingness is especially highlighted in our end-user interviews. Ubiquitous computing makes for the assumption that there will be ubiquitous gamification, assuming gamification provides the optimum interface for human-computer interaction (Oja and Riekki, 2012). Although there are still technological obstacles (P01 P02 P25), this can be expected to become less and less significant as time goes by (Smith, 2013). A determinant of this is the propensity of a society to accept gamification (Salen and Zimmerman, 2004). Our qualitative analysis indicates that this is a non-issue. Entertainment and overcoming boredom is an overarching theme and is seen as a top priority (P03 P06). Turning this propensity into a productive application of time is not an overstretch of the imagination. Drawing on the inherent playfulness of human beings (Huizinga, 1938), gamification is not introducing any foreign concept. With the increasing prevalence and accessibility of gamified experiences comes a natural increase in gamified processes. From sport to war, gamified interfaces have unleashed gamification onto all aspects of society (Fuchs, 2012). Our research supports that there is a valid and sensible economic rationale behind the increasing interest in gamification.

A counterargument against applying gamification to novel concepts is that with gamification becoming more prevalent, their effectiveness will be reduced, and consequently, novel applications of gamification such as in public health policy are not representative of a good return on investment (Bartle, 2011).The probability of reaching this state of redundancy is questionable according to the themes drawn from our research. If anything, gamification experiences have a long way to go (Participant A14), but gamification itself is not limited in its relevance, scope and potential for impact in the modern day context.

Motivation through gamification applies to everyone

The value of using levels and rewards to change the behaviour of participants through motivation is an important finding of our study. Nowhere has this been seen more than in digital applications aimed at improving the health and livelihoods of individuals (Lister et al., 2014). This study supports that there is general acceptance of the motivational affordances of gamification in all age categories. These inferences are in accordance with studies using similar sample populations, for example in graduate medical students (Nevin et al., 2014). From this, it can be perhaps purported that gamification can be used in more liberal and creative ways, without fear of rejection. It is suggested by Bittner and Shipper (2014) that solutions targeted at younger groups should employ gamification as a means to tap into the intrinsic and extrinsic motivations desired by a population now increasingly accustomed to ‘gamified’ living experiences. Whether this be through playing computer games, or through real-life games, the youth and wider public in general will become more comfortable with the idea of venturing into frontier challenging thinking and accepting new product solutions (Chun, Park, Eisingerich, and MacInnis 2015; Klopfer and Yoon, 2004). A result of this is that behavioural change stimuli may need more to become intense and divergent. This is supported by a dislike to monotony reflected in our research (P10 P21 P24). Our research indicates that gamification, through its grounding in social interaction, could be part of the solution to this. As suggested by E02, if game makers can create engaging experiences that incorporate gamification elements, such as the critically acclaimed video game series Grand Theft Auto that has an inherently flexible game architecture that is able to adapt to a player’s requirements to enter ‘flow’ state, there ought to be a certain transferability from the wildly successful hedonic applications to the utilitarian applications of gamification.

A consequence of this is that our research suggests gamification tactics theoretically have a universal applicability to all sections of the general population. Special attention should be made to eliminate certain unfounded biases. An example being that the elderly have 'grown out' of games and, hence will not benefit from gamification. This is a critical mistake as pointed out by Kapp (2014) because gamification and games are distinct and "not the same thing". Many believe the elderly have not been able to take full advantage of the advent of the smartphone, but as stated by Hong et al. (2016) , they still benefit from mobile technology. Internet literacy improved in the elderly through smartphone exposure, and our research implies the same for gamification. Exposure to gamification, regardless of ability to 'game', is recommended by our research. This is in particular due to the positive behaviour that serious games can inspire (Cugelman, 2013). Instead, ample consideration should be given to the different categories of users, an example being those who do not like rankings, and how best to enhance their gamified experience.

Demographics, Gamification and Behavioural Change

Our research, both from the quantitative results and from the expert interviews conducted, suggests that gamification tactics affect people differently based on personal characteristics and preferences. Throughout the literature, the effects of different game designs has been studied, yet minimal research has focused on the effect of demographics on an individuals' preference for certain gamification tactics within social media or serious games (Eisingerich, et al., 2015; Koivisto and Hamari, 2014 ; Stannett et al., 2016 ; Yee et al., 2012). Gamified features of ludic or hedonistic games have received much more attention and tend to have similar findings to ours. For example, in his study of the relationship between demographics and in-game preferences of *World of Warcraft* players, Yee et al. (2012) have found that male players are more likely to prefer competitive gamified activities, a finding supported throughout the literature (Williams et al., 2009 ; Yee, 2006). This reflects the results of our survey finding that males are more likely to agree to leaderboards than females.

Males were also found to be more likely to use games on their smartphone than females. Demographic differences concerning the usage of technology is found throughout the literature and used to provide recommendations to create new and appropriately tailored technology. Indeed, differences in both age and gender have been shown to affect the extent to which individuals value the usefulness of technology, the ease of use of systems and the differences in requirement for social interaction through the system (Morris and Venkatesh, 2000 ; Venkatesh and Morris, 2000).

A significant outcome of our research is that individuals' tendencies to be affected by certain gamified tactics also affect their usage of certain application categories. The significance of this finding is that gamification tactics, if tailored to an individuals' preferences, can increase the usage of the system in the long-term. Similar findings have been found in the literature. For example a small study of a web-based system designed to teach French grammar rules found that classifying users into 7 player categories and applying targeted gamification tactics according to these, increased the average time spent using the system by 39% (Monterrat et al., 2015).

Our research also suggests that preference for gamification may be a mediator for a particular preference of application category. Koivisto and Hamari (2014) have used this assumption in their study of the demographic differences and the benefits individuals' gain from different gamified features. Their findings tend to complement ours, supporting recommendations to employ social features to sustainably engage female users and to integrate users to the social network at an early stage (Koivisto and Hamari, 2014). Despite

our contribution to this constantly developing body of knowledge, there is a lack of research concerning less active users and the potential for gamification to improve their use and cultural background differences in the use perceptions of gamified services (Koivisto and Hamari, 2014).

We have found that the type of gamification required to support sustained behavioural change requires tailoring depending on individual demographic characteristics: a finding supported throughout the literature and explored through various proposed frameworks of implementation (AlMarshedi et al., 2015 ; DiTommaso and Taylor, 2014 ; Stannett et al., 2016). Stannett et al. (2016) present a theoretical framework of *Adaptive Gamification* aimed to leverage the intrinsic motivation of the player, by considering the player's unique characteristics. They advocate to first establish these unique characteristics (e.g. player typology, personality, learning style) and to develop the gamified features according to these and to translate these to adapt the game genre according to the player's preferences. These pertinent recommendations are based to a greater extent on past theoretical inferences and lack substantial empirical data to support them. Our study aims to provide a basic direction for future larger empirical research by identifying that preferences for gamification may be a mediator for a particular preference category and platform and that these preferences may be leveraged to improve motivation and scope for behavioural change in users.

Our findings advocate that new ways of using gamification for these purposes is expected to be generally *amenable*, and that gamification will have a *universal* effect, albeit of varying degrees, on the wider population. These findings make a case for the continued relevance of generic gamification, gamification that is not tailored to individual requirements, an example being the achievement system, Mozilla OpenBadges (Monterrat et al., 2014). Our research also proposes that the effectiveness of gamification, for the purposes of behavioural change in serious and utilitarian contexts, revolves around the *interactivity* and *specificity* (to the target demographic) of the solution. This infers that there is a role for adaptive gamification: gamification that considers personal characteristics (Sedeeq et al., 2016).

Merging the findings of our research and current literature we developed the following schematic for developing gamification solutions. Figure 7 illustrates our idealised evolutionary process, starting from 'Amenable' and finishing with 'Specific'.

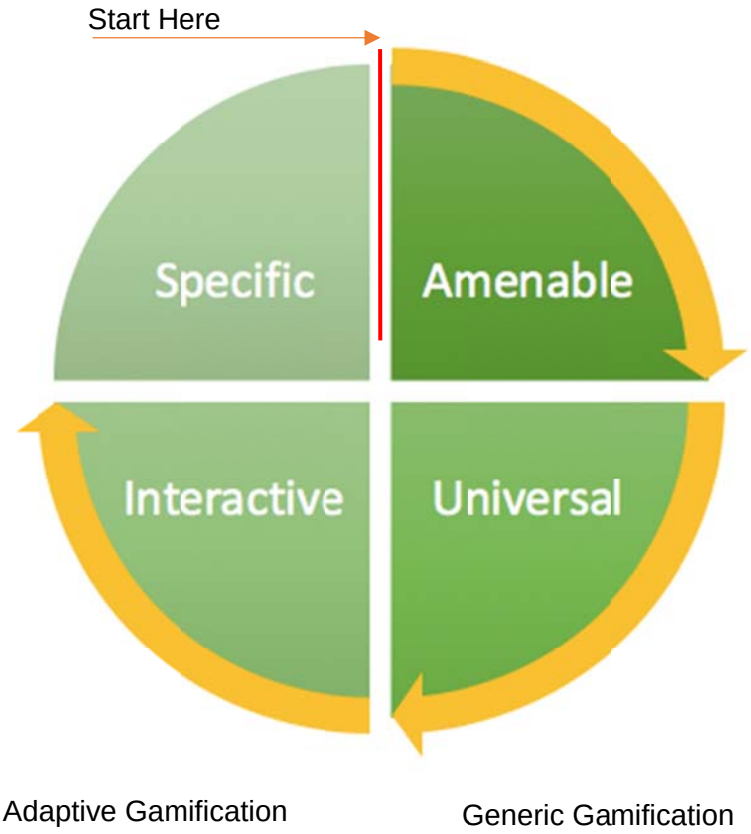

Figure 7: Proposed New Gamification Development and Implementation Cycle

Potential for gamification in public policy

Attention to gamification elements is arguably only of real value if gamification provides the possibility of creating utilitarian value in the real world, in particular, increasing the effectiveness of public health policy both in preventing and treating disease.

Public health, and policies that are devised to enforce it, form an important part of primary healthcare services, particularly in prevention of certain diseases such as obesity. Overall spending in England and Wales on public health interventions demands significant expenditure, rising to nearly £3 billion for local governments in 2014/15 (Local Government Association, 2013). However, adherence to public health policies has proven difficult to achieve, with low overall coherence rates (Jebb et al., 2013). Ultimately this leads to increased costs for the healthcare system (Iuga and McGuire, 2014).

A wide range of policies aimed at tackling the obesity epidemic are currently in place, "including support for breastfeeding and healthy weaning practices, nutritional standards in schools, restrictions on marketing foods high in fat, sugar and salt to children, schemes to boost participation in sport, active travel plans, and weight management services" (Jebb et al., 2013). This includes initiatives such as the Change4Life campaign (Jebb et al., 2013), the licensing of the 5-A-Day logo and the Eatwell Guide (Department of Health, 2016). Yet

annual national surveys do not show a reversal of the trend of increasing obesity throughout the UK (Jebb et al., 2013). One expert describes the "*future in gamification as an adjunct in health policy*" (E04). Whilst applications cannot replace the value provided by primary health provision, there is a role for gamification to supplement and provide regular guidance and feedback to people wanting to improve their health. This would act as an aid to current weight management practices, enabling individuals to partake and engage in healthy behaviours.

One study estimated that public health campaigns on average affect 5% of the population targeted (Snyder, 2007), however, according to a meta-analysis in 2010, online behaviour change technologies have the potential to double this (Cugelman et al., 2011). An end-user explains that "*an app might be better because it keeps you engaged daily, whereas a doctor you can't see daily*" (P03). With increasing pressure on health services, an application targeted at behaviour change may be a useful addition to current practice to relieve the burden of primary prevention efforts. Therefore, there is potential for gamification in public policy.

Current interest in the area is reflected in an increase in the available literature regarding behavioural change methods meeting the aims of public policy. A prominent, recent example of this is the MINDSPACE framework (Dolan et al., 2010). This framework outlines six key actions that policy makers can use to apply the influencers of behaviour that they define into practice. Two of these, 'Enable' and 'Engage' are noteworthy as they have the potential to be facilitated by elements of gamification (Park, Eisingerich, and Park, 2013; Wortley, 2014). 'Enable' recognises barriers that may exist preventing successful behavioural change, such as resources, infrastructure or facilities. Gamified experiences address this as they provide a new platform that create scope for behavioural change in a way that suits the individuals using them. Creating social interactivity platforms to support change in the wider population is therefore a key requirement for the success of a gamified public policy framework. The second factor, 'Engage' is where the gamification tactics described throughout this paper truly show their potential for public policy. This factor deals with how the target group of a particular policy behaves with regards to the guidelines that have been set, and how they interact with it. Gamification tactics promote interaction between the user and a technology or activity, as elicited in our research, and hence these tactics are well positioned to enhance engagement of a population to public health policies.

As explained previously, gamification provides a set of techniques and tactics which have the potential to change health behaviour and increase engagement for certain habits and activities. Given the current issues in cost and adherence to public policy, there is potential for the application of gamification to challenge the status quo regarding implementation of certain health policies and reshape how the general public achieves desired health targets and goals as devised by local and central governments.

Our findings suggest that gamification cannot stand on its own and will not replace traditional types of public policy interventions, at least not in the near future. Research has been carried out in the context of education, on how incorporation of gamification into the learning environment can improve educational effectiveness. Kim and Lee (2013) describe this in their paper on the dynamic model of gamification, comparing it to traditional teaching methods. They state that due to various constraints such as learning tools, the classroom and teaching staff, educational effectiveness is constant over time. The impact of gamification can be represented by a very different sigmoid-shaped curve, developed and repurposed from the Verhulst model for growth of human populations by the authors. Initially the gamified approach lies below the 'traditional line', however, over time it approaches an inflection point, whereby gamification becomes more effective. The areas below the curves illustrate the estimated effectiveness of both approaches. It is worth noting that the area below the

'gamified approach' curve is larger than that of the 'traditional policy approach' line over time. This concept can be extended to the area of public policy. It is evident from shading under the curve that the effectiveness of gamification exceeds traditional approaches over time, despite being less effective initially. This is further highlighted by one expert interviewed, stating "only a superficial amount has been tapped into so far" (E01).

The challenges of gamified principles in healthcare delivery have not been explored in-depth and one interviewed expert stated that further technological advancement could greatly enhance uptake of gamification (E01). This requires the public to have the ability to understand novel digital initiatives and adapt to this method of receiving healthcare. Adequate planning is therefore essential to enable potential users to fully access and make use of a gamified intervention.

Maintaining the privacy and security of a gamified digital initiative is an important consideration that policy makers and digital developers must take into account. Interview participants revealed concerns regarding the safety of sharing of personal information and this concern was supported by E01 who states that governance and security in health applications must be better managed. Research conducted by Evidon found that 20 of the most visited apps transmit information to a web of nearly 70 companies, leaving personal identifiable information more available and more vulnerable to attacks (Steel and Dembosky, 2013). It is therefore necessary to improve encryption and security practices in order for the public to have confidence in gamified digital proposals to ensure its widespread implementation and use.

There may also be some ethical concerns regarding gamification. As gamification tactics can be used to affect a person's behaviour, particularly if used in areas of public health policy as is suggested by this research, then it can be argued that individuals' autonomy is being affected. There is considerable debate regarding the merits of a paternalistic approach to public health initiatives versus allowing individuals to make autonomous decisions about their health behaviour (Bayer, 2007 ; Buchanan, 2008). The introduction of gamification into this debate may pose a complex matter and requires consideration regarding to what extent it affects individual autonomous rights. For example, if rather than restricting autonomous choice as public policy often aims to do currently (Friedman, 2002), gamification tactics merely increase preference for a preferred choice as decided by a public health initiative, this could be considered to be infringing on autonomy. Conversely, it can be questioned that this is in fact *increasing* autonomy compared to current methods employed. As research and knowledge in gamification continues to expand, these ethical dilemmas will become more prevalent, and existing ethical framework suggestions (Marczewski, 2015 ; Versteeg, 2013 ; Zichermann, 2012) must be developed to allow for responsible use of gamification tactics and techniques.

There is also the pertinent issue of whom the responsibility of supporting the planning, development, implementation and maintenance of the policy falls upon. The proposed introduction of a gamified initiative is a novel concept, and the government would require the assistance of application developers and technology firms. The experts interviewed suggest that it would be private companies who would lead the development as they are more technically adept and financially able. E02's opinion is that the government cannot challenge private entities as the government "*just don't have as deep pockets or interest*" and "*they don't have the resources and talent*." It would therefore involve a collaboration between the government and private entities to bring a gamified initiative through public policy into the market. This opinion is elaborated upon by Bryden et al. (2013) who advocate for a partnership between public health and private organisations to solve the issue of a lack of evidence base. Examples of such partnerships already exist in the UK with organisations such as the Behavioural Insights Team (Halpern, 2016) and Google DeepMind (Quinn, 2016),

both having been given access to patient data and information to efficiently fill the gap between technological or scientific advances and the provision of cost-effective interventions.

Essentially, the root of the solution is dependent on whether gamification can successfully achieve behaviour change. To answer this and ensure that a gamified digital initiative can successfully improve the population's health and wellbeing, research is required regarding the psychology and effects of gamification. Our results from both qualitative and quantitative analysis indicate there is a promising relationship. E02 states that government "*can support gamification interventions by putting (in) the resources*" if it is backed by concrete evidence. Given the potential gains of gamification, there is certainly reason to be optimistic about the future opportunities that gamification could bring.

Future research

Gamification is still considered in its infancy (Zichermann and Cunningham, 2011), and our study has shed further information between the link of motivation and gamification. There are still many more avenues to explore. Volkova (2013) ended her paper with the following reflection: "… it's time to use gamification more actively for solving social problems, isn't it? How exactly can we use game elements to motivate people in serious vital spheres like public policy and social endeavour?" Our study has attempted to provide an answer, however, this calls for more research to be done.

We invite future work to employ a greater and wider sample. This would allow a more robust statistical analysis to be carried out. The focus would allow greater focus on demographic and other customer differences and how best to personalise gamification accounting for individual differences, similarly suggested by Koivisto and Hamari (Eisingerich, Bhardwaj, and Miyamoto 2010; Koivisto and Hamari, 2014 ; Stannett et al., 2016 ; Yee et al., 2012). Our findings are focused on age and gender demographics, however, future research could benefit from exploring other factors. This includes but is not limited to income levels, education and cultural differences and their potential role in the uptake of gamified processes.

Our research has provided further insight and understanding into the link between motivation and gamification, including its potential. Through this process, recommendations for future research have come into fruition and testing our recommendations in the field would be a possible future avenue. The implications of gamification are vast; it has the potential of being applied to many areas in society. We should not neglect the possible benefits that we could incorporate to help individuals make changes in their behaviour. A particular focus of this study was the incorporation of gamification into policies related to weight management, however, the applications can be explored in further areas such as smoking, medication adherence and sexual health to name a few.

King et al. (2013) stated that in the future, there may be a value in utilising existing platforms developed by private companies, with input from academics and clinicians, to introduce behaviour change interventions. This is a promising space which currently lacks substantial research. This is not merely a fad, or gimmick. Positive behavioural change can have the capacity to radically improve one's health. Implications for predicting customers' future behaviours, hospital design, and on finance would be beneficial for society as a whole, as preventative measures for disease will incur savings compared to treatment (Eisingerich and Boehm 2009; Ramachandran, 2009; Seifert et al., 2015). The Behavioural Insights Team (BIT) have been working at subtle ways to alter the way we act, look after ourselves and obey the law. Gamification has a place here. Ultimately, by utilising gamification with supporting organisations, it is possible to enable people to make better choices for themselves.

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