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# Exploring the Risk Factors of Interactive E-Health Interventions for Digital Addiction

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## ABSTRACT

Digital Addiction refers to a problematic usage of digital devices characterised by being excessive, compulsive, impulsive and hasty. It is often associated with negative life experience such as anxiety and depression. To combat Digital Addiction, interactive e-health intervention applications started to appear to aid users adjust their usage style. The present study aims to understand the risks related to such e-health interventions. The authors conducted an empirical research to investigate such risks from users' perspectives through a diary study. Fourteen participants were recruited and asked to install popular "digital diet" applications and use them for two weeks and record their significant moments. The authors then interviewed the participants to discuss their experience. Self-governed interactive e-health intervention for digital addiction could lead to adverse side effects such as lower self-esteem, misconception of the healthy usage and creating an alternative addictive experience. Thus, there is a need for theory-based development and rigorous testing for such e-health solutions.

## KEYWORDS

Digital Addiction, Digital Diet, Interactive E-Health Interventions, Self-Regulation, Technology Addiction

## 1. INTRODUCTION

Digital Addiction (DA) is a term used to denote particularly problematic usage of digital media, often associated with negative consequences such as distraction, lack of sleep and reduced social skills. While there is still no authoritative definition for this condition, DA has been argued to include various sub-types such as internet addiction, gaming addiction, cyber-relationships addiction, and information overload (Young & de Abreu, 2011). Although DA is not yet formally classified as a mental disorder in the 5th and most recent edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM) (American Psychiatric Association, 2013), it does acknowledge pathological internet gaming as an emergent phenomena and possible disorder which requires additional research. This somewhat ambiguous status within the DSM is a reflection of ongoing debate on whether extensive internet use is an issue for concern (Yellowlees & Marks, 2007) or just a new lifestyle, i.e. "highly promoted tool" (Young & Rodgers, 1998). However, regardless of clinical status the phenomenon is becoming a recognised global concern with a growing need to provide effective and accessible health interventions for users to at least re-gain control (Montag & Reuter, 2015).

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The introduction of software-based solutions to health interventions has provided a potential template to promote effective management of digital life. Some studies and initiatives, such as Ko, Choi, Yang, Lee, & Lee (2015a), Ko et al. (2015b), and Lee, Ahn, Choi, & Choi (2014), have made an attempt to generate technological opportunities to shift from traditional web-mediated interventions to more intelligent systems utilizing recent innovations such as gamification and persuasive technology.

Despite the potential benefits of facilitating technology in delivering interactive, real-time, and intelligent interventions, there is still a stark lack of credible knowledge-base of such solutions. For instance, software-based mental health interventions, such as the ones in NHS library (NHS, 2015), are argued to fail in providing clinical evidence of a long-term change (Leigh & Flatt, 2015). One of the reasons for this failure could be the lack of robust integration of these technologies with traditional health care systems, coupled with the poor application of psychological theories such as self-regulation (Leigh & Flatt, 2015).

Peer support groups have been recognized as an effective treatment approach in rehabilitation programs for addictive behaviours (Bassuk, Hanson, Greene, Richard, & Laudet, 2016). Individuals are gathered together with peers who share similar experience and conditions to engage in activities that involve mutual help, social interaction and emotional support to improve psycho-social wellbeing and to re-integrate them to their communities (Sarrami-Foroushani, Travaglia, Debono, & Braithwaite, 2014). These groups revolve around social participation and interactions under the supervision of addiction counsellors, e.g. trained ex-addicts, to eliminate any deviant behaviours that may arise, such as introducing other addictive behaviours by peers or minimising the perceived risk of others. E-health intervention systems can apply this approach as well as reacting intelligently to any negative side-effects that may appear in group communication, such as social loafing and compensation (Simms & Nichols, 2014). Yet, it is still ambiguous how to translate what works in face-to-face social groups to virtual environments that mediate positive behavioural change. This is due to the unique aspects of online social structures and associated dynamics, e.g. the online disinhibition effect and its factors which include anonymity, asynchronicity, solipsistic introjection, dissociative imagination, and minimisation of authority (Suler, 2005).

E-health intervention systems need to be enhanced in terms of evaluating their target audience in order to offer the right treatment options. For example, gamifying systems could be risky for individuals with Attention Deficit Hyperactivity Disorder (ADHD). ADHD, which is a group of behavioural symptoms that include inattentiveness, hyperactivity, impulsiveness, short attention span, restlessness or constant fidgeting and being easily distracted (NHS, 2014), is a symptom of having DA (C.-H. Ko, Yen, Chen, Yeh, & Yen, 2009). Those with such behaviours are vulnerable to developing dependence behaviour or addiction in severe cases to gaming (Bioulac, Arfi, & Bouvard, 2008).

Despite improvements in the technology and the understanding of the psychological processes that promote behavioural change, there is still a need to shift the emphasis towards the group process and dynamics in the analysis of the system. This is due to the fact that a wide range of the software-based facilitated activities are offered under the remit of peer support environments. Yet, satisfying collective group values does not exempt the system from considering individual differences, needs and preferences. While such complexity in the individual level is left to moderators' group facilitation skills then in a series of complement approaches such as one-to-one counselling, we argue that software systems can still complement these efforts.

In our previous work (Alrobai, McAlaney, Phalp, & Ali, 2016b), we looked at the relationship between treatment programs, social structures in rehab-based communities and possible software-based interventions. In this paper, we focus on the socio-technical issues that might influence the design of e-health intervention for DA. Socio-technical systems call for accommodating social requirements to recognize social values such as trust, fairness and justice (Whitworth, 2009). Mumford (2000) also highlighted the importance of the democracy as a social value as people who are part of the system should participate in the decisions that concern them. This is also known as commitment and consistency, i.e. people feel obliged to what they committed to (Cialdini, 2009). However, there is lack

of guidance on how to apply this design principle in e-health intervention for addictive behaviours. For example, how to include individuals who might have unconscious bias, conflicting requirements and denial of reality (Alrobai, McAlaney, Dogan, Phalp, & Ali, 2016a), e.g., ex-addicts might be also relatively biased to their own past experience (Alrobai et al., 2016b).

We conduct an empirical user study to capture how users perceive the utilization of interactive e-health intervention for regulating DA. The study aided the identification of five main risks in these systems. This research was mainly based on a diary study followed by interviews and utilised a range of de facto smart phone applications to aid users adjust their digital usage via a range of persuasive and behavioural change features. The findings of this study are intended to inform the design decisions, testing, and usage instructions related to interactive e-health solutions for problematic and addictive digital media usage.

## **2. METHOD**

### **2.1. Participants and Recruitment**

We conducted a diary study that asked participants to install popular mobile applications designed to manage digital media usage. The selection criterion was restricted to IOS and Android platforms to ensure the compatibility with the participants' smartphones. The popularity of these applications was measured by having applications with over 1 million downloads and no less than 5K reviews provided by end users. Participants were recruited using convenience sampling. The included participants were screened for indications of DA using a three-item tool based on CAGE questionnaire (Ewing, 1984). CAGE is originally used as a screening instrument for alcohol dependent issues. The final sample consisted of 14 participants, 5 females and 9 males, with ages ranging from 18 to 50.

### **2.2. Study Design and Procedures**

Diary studies and semi-structured interviews were performed. The diary studies aimed to obtain participants' feedback in naturalistic settings while they were using an interactive e-health intervention application. This also gave participants the opportunity to engage with the application and to increase their familiarity with it. The participants were asked to install one of the selected applications on their personal mobile and use it over a 14-day period to reduce the impact of the so-called "wow effect" from a new technology and a new discovery of the actual usage. Table 1 outlines the key persuasive features included in the selected e-health applications. We categorized them based on the support strategies and behaviour change principles they utilised. This process also helped to decide the prominent and significant features of these applications as well as the requirements and contextual factors that can influence their effectiveness. The majority of these features found during the analysis of collected data are listed in a previous study by Oinas-Kukkonen and Harjuma (2009), while the rest is explained in Table 2. The key difference in the domain of DA as compared to other addictive behaviours is the fact that this problematic behaviour, i.e., the usage, can be traceable and addressed in real-time in a way which is transparent to users. For example, while coercive techniques cannot be provided in e-health interventions for other health-related issues, such as alcohol dependence, they are more feasible for intervention for digital addiction through actions such as locking a game.

Participants were asked to report their feelings and observations about the interaction with the selected application during their actual usage. They were also asked to take snapshots of the screen whenever they encountered an important interaction, then type on each one to facilitate recalling their feelings in the follow-up interviews. All these activities helped to immerse the participants in the domain so that the interviews allow us to get more insights.

The questions of the follow-up interviews were built based on these diaries entries to get deeper understanding of users' comments, and to collect more insights. For example, most of the interviewees highlighted in their diaries that these applications are annoying but effective. This guided us to

Table 1. E-health intervention features

Features	App.1	App.2	App.3	App.4
<b>Actions facilitation features</b>				
Monitoring & tracking	•	•	•	•
Coercive techniques	•	•	•	•
Goal settings	•	•	•	
Tunnelling				
<b>Motivational sparking features</b>				
Competition		•		•
Normative influence			•	
Recognition			•	
Social support		•	•	•
Comparisons	•			
Rewarding	•	•	•	•
<b>Signaling features</b>				
Reminders	•	•	•	
Insights messages		•	•	
Addiction scoring		•	•	

Table 2. Descriptions of the extra e-health intervention features

Features	Description
Coercive techniques	E-health applications for DA should provide means to help users apply restrictive rules.
Social support	E-health applications for DA should provide means to enable users to send messages such as liking to utilise the influence of peer support.
Insights messages	E-health applications for DA should provide plain or visualised feedback messages that are generated based on users' actual use to indicate when a behaviour is appropriate. Addiction scoring can be seen as an example.
Addiction scoring	E-health applications for DA should provide clinically validated masseurs to assess the level of addiction. It has been listed as a standalone feature to emphasis its important impact and the need for careful measurement and feedback.

investigate this paradox in the interviews to understand the source of annoyance and whether that can be minimised without reducing the perceived effectiveness. The diaries have also highlighted other important aspects related to using the application occasionally to cope with stress, the language used and the need for unique set of preparation before using the application, e.g. what to expect and the potential negative feelings such as frustration. The Appendix includes a sample of the interview questions. The interviews were then transcribed and content analysed. The analysis phase included three evaluators, two to run the coding and categorisation, while the third to make a decision when consensus could not be reached.

### 3. RESULTS

This section reports core risks which were identified through users' experience with such e-health solutions. We also explain the risk in relation to psychological theories aiming to inform the designs and testing methods of such technology to anticipate and minimise their negative impact.

#### 3.1. Risk 1: Unsustainable Change

Behavioural change interventions aim to reduce the individuals' damaging behaviours. Facilitating the initiation of that change through goal settings can be the first step in the process of change, with subsequent tasks focusing on maintenance of that change (Gollwitzer & Sheeran, 2006). Locke & Latham (2006) explained the types of goals in goal setting theory. The first is learning goals, which are about increasing competency by focusing on skills and knowledge acquisition. For example, finding new healthy ways to cope with stress away from the excessive use of digital media can reflect the level of the performance. Second are performance goals, which focus on rewards to provide a sense of accomplishment to reflect the level of competency. For example, setting a goal to reduce unhealthy usage of mobile phone in order to be on the top list of a leaderboard. To sustain behavioural change, learning goals can be more effective than performance goals. Learning goals can motivate goal pursuit when dealing with failure (Seijts & Latham, 2005). In DA, what we mean by failure is returning briefly, i.e. lapse, to addiction behaviour or failing to apply the acquired skills in the treatment program. This is because in the early stages of the treatment, addicts might experience initial difficulty or failure to mastering new skills. Therefore, learning goals can increase self-efficacy as users invest more time to discover appropriate strategies to achieve better quality performance, while attention is diverted away from the end results. As such, motivating users to explore what triggers engagement in addictive behaviours can be a critical asset in e-health intervention for regulating DA, and is therefore an important step in achieving behaviour change. In the case of DA users could be provided with the means to identify what applications contribute to their excessive usage. Ultimately, it is suggested that in an environment with minimal structure or guidance, metacognition is necessary (Locke & Latham, 2006). The authors argue that metacognition which refers to "planning, monitoring, and evaluating progress toward goal attainment" can be enhanced through learning goals.

While the continuous and accurate monitoring of usage through e-health applications can provide such knowledge, our study indicated that this knowledge has as short-term influence to regulate the usage. For example, a participant commented that "it just tracks usage, while usefulness depends on your willpower." Another participant commented that "it has not changed my attitude towards my usage, only made me reduce the usage and manage the time spent on it." While this means a successful intervention, motivation may only be temporal and not yet embedded intrinsically in the user. Thus, the real challenge here is to empower self-control and sustain the motivation to encourage long-term change.

To sustain a behaviour change, one participant commented that they always like to "compare if they have spent less time than their peers." This indicates the potential of the online peer pressure and social comparison which are typically used in peer support groups (Alrobai et al., 2016b). However, some social influences, such as conformity effect, suggest the risk of adjusting the behaviours temporarily to conform with peers. As an edge case, one participant commented "family members would be distracting in the online peer groups as I may feel I need to behave differently." This suggests the need for considering the social structure of peer groups, and how it should be set up to promote group cohesion and performance in such socio-technical system, and to sustain the positive change.

Loss of interest is another sustainability threat in these systems. During the diary study, most participants reported their interest in these applications, but none of them continued using them after one month from the end of the study. This is also supported by the comments of users in the forums related to these applications. Many participants criticised the obtrusiveness of some of the techniques "annoying, but that is the purpose" which still positively express their tolerance. However, they

expressed their eventual loss of interest mainly due to the fact that the applications are measuring and trying to treat the usage but not the underlying reasons and context. This can be linked to the need for a preparation stage before using these applications to understand their limitations and what to expect from them.

Another highlighted threat is experiencing failure to engage. When an intervention is conducted in a socio-technical context, users may experience a negative feeling when they do not receive the expected support from peers. They may also fear violating group's norms, such as indicating their depression state in a group that always praise positive stories to promote hope (Sandaunet, 2008).

This risk is not only associated with e-health applications that utilise social aspects, but could also be the ones that solely rely on the self-regulation rather than peers "I am still over using my phone. Uninstalled." This is a classic case when users expect the application to be a remedy rather than a facilitator. Setting up the expectations of such applications would be essential for their success.

Loss of interest may be also caused by poor levelling design of the intervention. This mainly stems from the limited consideration of the stage of change, e.g. those of the Transtheoretical Model (TTM) (Prochaska, 2013) or the level of addiction, i.e. early, intermediate and severe. As such, the system might deliver mismatched interactive interventions. Thus, users should be carefully assigned to each level without being confirmatory and without overlooking their contextual factors and also the open issues in judging stages and their linear and sequential nature, e.g. the issues with such assumptions in the TTM (Sutton, 2001).

### **3.2. Risk 2: Lowering Self-Esteem**

Comparison techniques were evident in all the DA regulation applications that we investigated. For instance, an application is expected to compare the current behaviour to the past-self, peers, or comparing to a self-set goal or a collective goal set by the group.

Comparing with peers' digital media usage is a social computing element that can be used in e-health interventions to enhance users' motivation and prompt behavioural change. While comparing self-performance with others can help to define the self, the approach may inadvertently also create competition. In this case, there is a possibility to impact self-esteem and self-efficacy (our perception of how able we are to control and change our own behaviour). This is particularly if a user who is in the early stages of the change, e.g. contemplation, is compared to others in the advanced stages, e.g. maintenance. Although an upward social comparison is suggested to inspire those who are in worse off condition (Taylor & Lobel, 1989), it may also severely lower their self-esteem. For instance, a user commented that gamifying the systems can be effective but always with caution as "fun [in using some point system] is needed but what about non-addicts appearing in a leader board?!" In other words, having users with different degrees, types and perception of addiction in a comparison could have adverse effects. This also applies for those who are in the better off as they may use it as a defensive mechanism and ignore other symptoms of addiction such as salience, withdrawal symptoms and conflict, which may be more problematic than the time spent on digital media.

### **3.3. Risk 3: Creating Misconceptions**

Judging DA, e.g. via providing a score, could be perceived as an effective motivation "I think it makes me want to improve and get a lower score sometimes." However, the methods to judge tend to be inherently partial, i.e. overlooking some factors such as the motivation of the usage, and subjective due to the complex network of factors describing an addictive behaviour. In calculating addiction score, tracking time on-screen was the predominant method in all the reviewed applications. Different applications were found to rely on different metrics to measure time on screen. Users commented that these applications had the risk of lacking intent identification. As such, all types of usage were included in the measurement models of these applications without considering users' goals, needs and contextual factors.

Another common measure within the DA applications is the frequency of checking and using digital media. Some of the applications were reviewed in this study provided frequency-based statistics, such as number of screen unlocks and an application's lunches. One of the reviewed applications took into account these stats with other unstated factors to calculate addiction scores using undeclared and possibly un-validated methods. There was also a feature of linking the usage to the geographical locations which could be seen a relevant factor. For example, if the usage is only increasing in certain places, e.g. workplace, this might indicate a temporal reason. These statistics can provide indications to the degree of resisting the urge to use digital media. However, there is still a lack of standardised methods to collect and report these frequencies and utilise them to draw a conclusion, e.g. for pattern of addiction and effect of time and location as well as social context.

The use of such quantifying methods, i.e. time on-screen and frequency that are not validated could heighten the risks of providing false assertions. Some users doubted the scoring measurement, e.g. "two hours and fifty-five minutes of phone use should not be counted as 100 points [which is the highest addiction score] in the addiction scoring." The same user then speculated that "two hours should be like 85 points or 4 hours to be 100 points." This indicates that it was difficult to understand the rationale and perceptions of time and frequency and how they translated to a judgement (score) of addiction.

In fact, such misleading information might be abused by users to avoid having to engage in further treatment. This is by declaring that they have made a change in their behaviour and are therefore cured, despite the fact that their usage is still problematic. This known as the "flight into health" tactic (Frick, 1999). For example, one user commented: "I did not ever know how often I checked my phone, I was using it about 200 times a day. Now I check it about 200 times a week thanks to much for curing me." Part of the issue could be related to 1) the e-health literacy, i.e. the capacity of evaluating the credibility, quality and relevancy of health information, e.g. applications' feedback messages, provided in the cyberspace (Stahl & Spatz, 2003), 2) the lack of having standard labelling in this domain (Ali, Jiang, Phalp, Muir, & McAlaney, 2015) or 3) users' tendency to convince themselves that the change is sufficient and labelling is used as an evidence.

An objective measure, i.e., a factual one such as in the comment above, seems to be more effective to minimise risks of misconception. However, they might still need to be supported by careful feedback and reporting statements to avoid any deceptive assertions.

The designed levelling system can also lead to misconceptions as well. For example, one of the participants commented "if I reached the highest level [of being a non-addict user], I will not probably use it anymore as I would think that I'm already cured since I got the final level." The lack of theory-based DA judging and scoring systems makes any current system ad-hoc and misleading.

### **3.4. Risk 4: Creating Alternative Addictive Experiences**

Interactive e-health interventions for regulating DA aim to help users regulate their digital usage. However, our study highlighted the risk of such intervention in becoming a basis for alternative addictive behaviours.

The design of feedback messages about digital usage, e.g. scores and comparison to others, can follow pull or push approaches (Franklin & Zdonik, 1998). The former puts the responsibility on users to check their progress against their goals. The risk of this approach is that cognitive preoccupation is facilitated through the design, which might reinforce the feelings of anticipation. The latter approach puts the responsibility on the software to deliver the feedback messages reasonably and to facilitate monitoring the progress. This also has the risk of triggering unnecessary use after reading the messages and of users being preoccupied about the them.

The use of gamification mechanics to implement the element of fun can also lead to adverse effects (Callan, Bauer, & Landers, 2015), such as habitual checking behaviours. In one of the reviewed applications, where the experience was gamified through levels and points as well as avatars and epic meaning, the users liked to have more gaming elements to make the e-health application more

engaging, and one of the participants commented that “actually, it [the application] made me use my phone more because of these [the gaming elements] features.”

Finally, this technology might be used as a coping strategy which may convey a positive aspect. However, the interviews revealed the risk of that. Using the app as a quick coping mechanism to escape the stress rather than mitigating its sources may lead to use this technology as a new addictive experience.

### **3.5. Risk 5: Enforcing Biased Decisions**

Goal setting theory can offer users the flexibility to select their own goals in order to enhance self-efficacy and implement the element of ownership. However, in rehabilitation programs, setting SMART goals (Doran, 1981) is not an easy task to perform (Bovend'Eerd, Botell, & Wade, 2009). For instance, allowing users to decide the level of difficulty in the goal selection could slow the treatment progress. In fact, this might be perceived by users as an ineffective intervention option. Users may also be influenced by their past experiences, such as selecting a challenging goal which led to a failure. This could be due to the lack of guidance for users to decide the level of difficulty or due to a lack of proper system support to help the user to stick to the plan. Such negative experiences can influence future goals selection, which could lead users to continue to select goals that are easy to achieve.

When the behaviour change is facilitated within group settings, the complexity of tackling these negative aspects will be far more challenging. A common issue is that users have a tendency to change their behaviours to fit in with a group (Asch, 1951). As such their selection of the goals could be biased as they are influenced, perhaps by the norms of the group. Even after becoming a part of the group, social recognition may influence the behaviour “sharing my data with peers depends on how bad is my addiction score. If it was really bad, then probably not.” Another, related issue is that users may also have a tendency to pick easy goals to achieve a higher rank within their social network.

In addition, when social comparisons are implemented, users may indirectly provoke one of two comparisons; downward or upward. Downward comparisons are where users compare themselves to those who are in worse condition. Focusing on others who have more problematic usage may create tendency to select easier goals. In other words, such comparisons may not induce users to exert incremental effort as they may feel it is more needed by those in worse condition.

## **4. DISCUSSION**

This section presents some reflections on how design errors made within e-health interventions can impact users' behaviours and hinder group performance. These five risks, alongside their potential causes, are outlined in Figure 1. Ultimately, the partial overlap of these risks indicates the inherent complexity of designing such pervasive and interactive interventions. Unguided intervention designs may lead to considering certain aspects, e.g. increasing engagement, while neglecting others, e.g. enhancing self-esteem. This suggests that systematic engineering approaches and robust guidance to build such socio-technical systems should be established. By systematic engineering, we emphasise the importance of establishing instructions and heuristics rather than relying on creativity during the design activities. However, different design facets should still be explained by social psychology science to create solutions that best support the different behaviours and abilities of users and groups.

Therefore, social aspects, (e.g. social structures, roles and norms), and personal characteristics, (e.g. personality traits and level of dependency), should be considered as important aspects of these systems. In certain stages of the treatment, these systems might need to focus more on the community requirements rather than individual needs to promote the overall group performance. This may create challenges, such as how to promote group cohesion and reduce conflict. Further issues include how to increase trust, privacy and transparency when the group interaction involves a heavy element of self-disclosure; as well as how can this type of socio-technical systems assess the adjustment needed



[coercive] rule when they want to. Self-control is a limited resource that depletes as the day goes by.” Sparking, on the other hand, refers to triggering the behaviour by implementing motivational cues. For example, a participant commented “I would love if I could add more interesting/motivating messages when I violate a rule!” Clearly, these are needed to enhance self-efficacy to promote the readiness to change. Users always have different needs and preferences in terms of what techniques to be implemented. Yet, we argue that this is still need to be guided in the design phase. By guidance, we refer to the concept of best practices in the design of treatment programs.

The term universal design describes the concept of designing for all regardless of their age, gender and abilities (Center for Universal Design, 1997). In the domain of self-managed e-health applications for addictive behaviours, there is adequate evidence of the lack of consideration of the concept of equitable use (Center for Universal Design, 1997). This concept is essential to accommodate the abilities of users whose usage style can be described as obsessive, impulsive, compulsive and hasty. These properties explain why designing for behavioural change is far more challenging (Fogg, 2009b). We view the domain of behavioural change, as important effort to provide reactive approaches to deal with this issue. However, there is an evident lack of test frameworks to validate the effectiveness of intervention systems built based on the theories of behavioural change. Validating the effectiveness of such technology requires a set of pre-conditions such as willingness to change, openness to shortcomings, being free from denial of reality and also the seriousness of the condition. The challenge here is how to measure these factors, e.g. change readiness, to control their influence on the validity of the intervention system.

This demonstrates the need for a managed requirements and design personalisation process which involves a variety of stakeholders in addition to the users, who may tend to deny reality and have unconscious bias. Our study is intended to shed light on the need for careful design and also the new challenges which arise when developing software for addictive behaviour where users’ requirements have particular characteristics, e.g., being against their comfort and current desire to achieve a new behaviour in the long term.

## 5. CONCLUSION

This paper has explored some critical design risks associated with the development of e-health interventions for addictive digital usage. For each risk, we presented a discussion to illustrate how such design choices might have detrimental impacts to users. Overall, we believe that understanding these risks and how they can be minimised will increase the likelihood of more effective e-health interventions.

The paper also highlights that current efforts in e-health interventions are strictly addressed as a non-technical topic where the systems are just a telecommunication medium to deliver health interventions. The paper offers insights into the contribution can be made by the engineering discipline toward not only the management of e-health development activities but also the contribution of these systems to regulate DA.

In this respect, we view these interactive interventions as a socio-technical system and argue the potential for adopting socio-technical approach as a multidisciplinary approach to design e-health interventions for regulating DA. The challenge is to find out what are the group collective needs rather than desires. As any other type of treatments, it can be acceptable by patient, to certain extent, to tolerate short-term side-effects as a first positive reaction to the recovery provided through this technology, provided that individuals are made aware of these possible side-effects. Yet, more efforts are needed to identify the symptoms of those side-effects’ on both personal and community levels. Finally, what are the scenarios in which the system should react to negative practices such as unsafe dosage, e.g. implementing lots of rewards or badges, which could create confusion and distraction from HCI perspective. Another example is when newcomers to these treatment communities are offered competitive tasks, i.e. performance oriented goals, while they are might be at the stage of

being emotionally vulnerable. Collaborative tasks in this case might be the right one to start with in order to improve groups cohesion, while competitive tasks can be introduced carefully in later stages of treatment, e.g. relapse prevention stage. This is to create conditions for more successful interventions where ethical values are carefully considered.

Ultimately, this shift in the design methodology will introduce new emphasis on considering personalised and customisable interventions where also the concept of groups and their interactions and collective decisions is an essential consideration in the design activity. This should also facilitate the introduction of mass interpersonal persuasion (MIP) (Fogg, 2008) to socio-technical systems for behavioural change where individuals can freely seek peer support or voluntarily provide it.

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## APPENDIX

### Sample of the Interview Questions

Below is a sample of the questions informed by the diaries and used in the interview study:

- Before using the app, what did you think about your usage style so did you have a problem with it?
- Before using the app, what was your motivation to use it? Why?
- What would you think about incentives like an achievement or an award instead of using coercive techniques to stop you?
- Do you think there was enough personalisation in the app or do you think there could have been more?
- Would comparing your usage to your colleagues motivate you to change your behavior?
- On day 6, you said that you failed with the app. Do you think using the app is hard to maintain?
- Do you think that the app is missing some features that should be added?
- You mentioned before about using the application, you were stressed. And you say this particularly in day 7 so do you think your phone has become like a way of de-stressing like a way of coping or something like that?
- In terms of the app's language, was it neutral or judgemental? And which one you prefer? why?
- You said that the app is annoying but effective, but would that encourage or discourage you to continue using it?
- Are the app's notifications annoying by itself or because it just reminds you of your failure to control?
- Do you think that you should be prepared before using the app? And what sort of preparation you think you need?
- Do you think the app would need to know more about you and your social life in order to help you?
- Do you think the app is like a long-term thing or just a short-term thing?