Digital Intervention for Problematic Smartphone Use in Undergraduate University Students:

A Systematic Case Series

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Submitted in accordance with the requirements for the degree of

Doctor of Clinical Psychology (D. Clin. Psychol.)

The University of Leeds

School of Medicine

Division of Psychological and Social Medicine

June, 2020

The candidate confirms that the work submitted is her own and that appropriate credit has been given where reference has been made to the work of others.

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Acknowledgements

Abstract

Introduction: Smartphones have become the primary device for accessing the online world. The potential for smartphone use to become problematic is increasingly recognised, with students at particular risk due to their high usage and reliance. There is limited research evaluating interventions for problematic smartphone use. The present research aimed to develop and evaluate a digital intervention for problematic smartphone use in the student population.

Method: A mixed-methods case series design was used to evaluate the acceptability and impact of the intervention for ten participants. The intervention included: goal setting, personalised feedback, mindfulness and behavioural suggestions. Participants were asked to complete self-report measures of problematic phone use, online dependency, mindfulness, wellbeing, psychological distress, sleep and self-determination. Participants' phone use and sleep were also measured directly.

Results: The results provide evidence for the intervention package reducing problematic smartphone use, although there was no observable impact on overall screen time. There was some evidence of positive influences upon online dependency, mindfulness, wellbeing, and sleep. No particular component of the intervention seemed more effective than the others.

Discussion: The findings suggest that the intervention package is both effective and acceptable to students wishing to better manage their problematic smartphone use.

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1 Introduction

This introduction describes the changing role of digital technology and the online world, and the ways in which they have become problematic for some people. The literature relating to problematic smartphone use, as well as related technologies, is reviewed. This review outlines both problematic behaviours and the potential interventions for these. This review also considers how evidence from other problematic behaviours, that have similar underlying mechanisms, can inform the development of interventions for problematic smartphone use.

1.1 Use of smartphones and the online world

The present study is focussed on smartphone use, now the primary device used to access the online world (Deloitte, 2019). A smartphone, as defined by oxforddictionaries.com (n.d.), is: "a mobile phone that performs many of the functions of a computer, typically having a touchscreen interface, internet access, and an operating system capable of running downloaded apps". Smartphones are a relatively new technology, therefore much of our understanding of how people interact with the online world pre-dates the advent of smartphones. For this reason, within this literature review evidence pertaining to internet use will also be included. Given the ever-changing nature of technology, our experience of the online world will continue to evolve. We must continue to add to the literature whilst also utilising the understanding obtained relating to technologies that may become superseded.

Whilst smartphones existed in various guises prior to the release of Apple's iPhone in 2007, this release had the biggest impact on the way society use mobile devices (Frommer, 2011), owing to its high functionality. Since 2007, smartphones and the way in which they (and their associated applications) are used has continued to progress. Smartphones have now replaced a number of other objects/devices in everyday life for many people (Montag & Walla, 2016; Stenovec, 2015). Smartphones are the most owned connected device in the UK (Deloitte, 2019), and are identified by users as the most important device for accessing the internet (Ofcom, 2018). Objects/devices that smartphones are now able to (and commonly do) act as an alternative for include:

- clocks/watches;
- calendars/diaries;
- maps/navigations systems;
- cameras/recording devices;
- music players;

- calculators;
- debit/credit cards;
- televisions;
- computers/laptops;
- newspapers and books (and/or digital reading devices);
- physical tickets (e.g. flights, trains, events).

Smartphones are a device on which the internet can be accessed, but they have unique qualities when compared to other digital devices with internet connectivity. These qualities include: the possibility of being always on and constantly connected, compactness, flexibility and ease of use, applications, and ubiquity, all of which give smartphones the potential to produce new habits in relation to internet use (Oulasvirta, Rattenbury, Ma, & Raita, 2012). Smartphone users place great importance on the efficiency of use; it reduces the burden of tasks (i.e. the checking of emails), but may increase the frequency of checks and encourage checking habits (Thorsteinsson & Page, 2014).

A mobile consumer survey revealed that 88% of its 4000 UK respondents owned, or had access to, a smartphone in 2019, and 95% of those had used it within the last day (Deloitte, 2019). The ownership/access had increased by just 1% from the previous year, but was up 52% from the 2012 survey. The statistics indicate that smartphone adoption has rapidly increased but may now be reaching a plateau. Between 2012 and 2019 laptop ownership or access stayed within the range of 73% - 79%, suggesting that the increase seen in smartphone adoption during that period was specific to that device. Between 2017 and 2018 adults reported a decrease in the likelihood of using their laptops to access the internet, and there was an increase in the percentage of people reporting that they accessed the internet exclusively via their phone (Ofcom, 2018). People are also using devices simultaneously; more than half of the adults surveyed by Ofcom (2019) reported that whilst watching television they were usually using their phone. The devices people have access to, and the way in which they use them, is continuing to evolve.

The term "internet use" incorporates the use of any digital device (e.g. smartphones, tablets, laptops) to access the online world for a variety of purposes, including communication, leisure, and information seeking. Internet use has been increasing since its emergence in the 1990s, with 99% of 16-44 year olds describing themselves as recent (within the last 3 months) internet users in 2019 (Office for National Statistics, 2019). Research has explored problematic use of the internet and smartphones, as well as of specific online applications. Each of these have the potential to be problematic alone, and for some, there may be difficulties in regulating overall access to the online world.

Smartphone use (or any other means of accessing the online world) is considered to become problematic when it begins to interfere with an individual's daily living. Billieux et al. (2015) make reference to "dysfunctional mobile phone use", defining this as uncontrolled use that results in adverse consequences on daily life. The research into problematic use of technology to date has primarily focused upon defining and treating what is termed an addiction, whether that be to the internet, digital devices, or specific uses of the online world (e.g. gaming or social media). Although technological addictions are not considered to be a diagnosis within diagnostic manuals (see DSM-V, American Psychiatric Association, 2013) they are considered to be characterised by salience, compulsive use, withdrawal symptoms, escapism, negative outcomes, mood regulation, and social comfort (Lortie & Guitton, 2013). Lapointe, Boudreau-Pinsonneault and Vaghefi (2013) describe problematic smartphone use as a form of internet addiction, as most of the tasks and characteristics of internet addiction are embedded within the smartphone. This is added to by the unique qualities of smartphones; the constant availability of the smartphone changes the way the internet is used and may increase vulnerability to problematic use (or addiction).

The present study explores smartphone use. Problematic smartphone use appears to be closely linked to the concept of "generalised" internet addiction, which is understood to differ from problems with specific elements of usage. Griffiths (1995) discussed the overlaps between technological and other addictions (i.e. telephone sex addiction being both a technological addiction and a sex addiction), however, more generalised problems with technology use are now emerging. These generalised problems would not necessarily be defined in terms of another addictive or habitual behaviour. Brand, Laier, and Young (2014) explore the differentiation between generalised and specific internet addiction; they cite Davis (2001) in describing generalised internet addiction as multidimensional, understood to be non-directed and associated with time wasting, also suggesting that there will be overuse of multiple online applications. The smartphone easily lends itself to this way of using the internet, due to the ease of accessibility and the ability to switch between applications. This more generalised problematic use appears to present in a different way, and to be linked to different maintaining factors, when compared with more specific problems relating to internet use.

As there are no large-scale cultural comparisons of smartphone or online use, it is not clear whether (and to what extent) cultural differences are present. It is important to note that much of the previous research on this topic has been undertaken in the USA and East Asia (see Winkler, Dörsing, Rief, Shen, & Glombiewski, 2013 for a review of the literature), and that the present study used a UK sample.

1.1.1   Use in the student population

Almost all young adults use a smartphone; in the 18-24 age group the percentage of users increases to 93% (from 88% in the general adult population) (Deloitte, 2019). Young adults (16-24 year olds) use digital devices more regularly and spend more time using them, when compared to other age groups (Ofcom, 2016). Device preference also varies by age group; those under 35 show a higher preference for using their smartphone (over other devices) for all activities than those over 35 (Deloitte, 2019). This preference shifted between 2018 and 2019; where the 18-24 age group had previously preferred to do online shopping via a laptop and now choose their smartphone. The greatest reliance on mobile phones is reported in 16-24 year olds; 77% said their phone was the device they would miss the most if it was taken away, whereas just 5% said television (Ofcom, 2018). This high usage and reliance places young adults at increased risk for developing problematic smartphone use.

The most recent figures estimate more than 50% of young people will be participating in higher education by age 30 (Department for Education, 2019). It is pertinent to pay attention to the role smartphones will play in students' lives, and the potential resultant problems. Supporting this, Young (2010) described higher prevalence rates of internet addiction within students, with a suggestion that encouragement of use (e.g. by peers socially, by universities/colleges for academic purposes) within this population is a contributing factor. Internet use has become embedded within the student population and individuals are becoming reliant upon it as the quickest and easiest way to communicate and seek information (and smartphones as the most efficient way of accessing it). The embedded nature of internet use is not in and of itself problematic, however, it does increase one's reliance upon it and therefore may increase vulnerability to problematic use. The embedded nature also normalises heavy use of the internet and smartphones, which may reduce one's ability to recognise when it has become a problem. A UK study identified that of 79 university student participants, the majority (54%) scored within the mild range on the Internet Addiction Test (which measures the severity of problematic internet use), and a further 9% scored in the moderate range (Genova, Bewick, & Summers, 2016). These findings suggest that many students may be displaying low level problematic behaviour in relation to their access of the online world, albeit according to self-report measures.

1.2 A review of the literature exploring problematic use and its consequences

The possible consequences of smartphone use, and the online world, cannot yet be fully understood. Literature exploring the potential consequences for users is presented here. The exploration of these consequences supports an understanding of the topic and emphasises its importance. This review also informed the development of the intervention being evaluated in the present research.

Smartphones, like anything else that is potentially addictive, are a double-edged sword, in that usage has both pros and cons. Advantages of smartphone use include optimised communication (Geser, 2004 in Billieux et al., 2015) and on-the-go convenience and efficiency (Nath & Mukherjee, 2015), amongst others. There is a growing concern, however, that the overuse of smartphones can have negative consequences. Some examples of negative consequences are listed below:

- Those engaging with online communities have been shown to have reduced involvement within offline communities (Nyland, Marvez, & Beck, 2007).

- Students with the highest mobile phone usage report significantly higher levels of isolation, loneliness, anxiety and depression than those with the lowest usage (Peper & Harvey, 2018).

- A deterioration in academic achievement in Facebook users has been reported, suggested to be owing to distraction and procrastination (Kirschner & Karpinski, 2010).

- Problematic mobile phone use is associated with poorer sleep quality in the student population (Demirci, Akgönül, & Akpinar, 2015; A. White, Buboltz, & Igou, 2010), which may also link to concerns regarding wellbeing and academic performance.

- Those struggling to control their smartphone usage are likely to be distracted from more important tasks; perhaps leading to delayed completion, or even risk of serious harm. A key risk detailed within the literature is texting whilst driving (White, Eiser, & Harris, 2004).

As the examples above show, internet and technology use can have a negative impact upon both productivity and wellbeing (Montag & Walla, 2016). The internet has, to some extent, made life and work easier (e.g. by improving speed and efficiency), however, the relationship between smartphone/online usage and productivity has been reported to resemble an inverted-U shaped curve (Montag, 2015, in Montag & Walla, 2016). The suggestion is that the distractions present on digital devices (e.g. notifications) disrupt the

flow of productivity. This is evidenced in university students, where those with higher levels of problematic smartphone use showed greater difficulties with flow and self-regulation whilst studying, which may be linked to their inability to ignore phone interruptions (Lee, Cho, Kim, & Noh, 2015).

There is evidence that smartphone users often multi-task, including via another digital device, using more than one app on their smartphone, and with non-digital activities (Lim & Shim, 2016). Multi-tasking has alternatively been described in this context as "semitasking", whereby none of the tasks are being fully engaged with (Peper & Harvey, 2018). This has been demonstrated in experimental research; those with a tendency towards high levels of digital use and digital multitasking had greater difficulties ignoring interference from unimportant stimuli, and this negatively impacted task performance (Ophir, Nass, & Wagner, 2009).

It is suggested that some technology has been deliberately designed to be addictive (Browne, Pitts, & Wetherbe, 2007; Thorsteinsson & Page, 2014). Examples of this include the use of intermittent variable rewards (e.g. likes on social media), known to increase the likelihood of addiction, as seen in slot machines (van Velthoven, Powell, & Powell, 2018), and the use of notifications designed to attract attention (and thus, to pull it away from other things). An individual's tendency to orient themselves towards notifications is automatic, it requires little to no cognitive processing (Peper & Harvey, 2018). This automaticity means that it will occur even when the content does not demand attention, and the decision of whether to engage is one that must be made subsequently, after the distraction has occurred. This offers an explanation as to why smartphones may disrupt even the most important of tasks and highlights the importance of effectively managing notifications, or taking time away from our phones. We can infer from the literature that notifications are a feature that have potentially problematic consequences.

As already stated, smartphones have replaced many items, this means that users are becoming more reliant upon them as they become more integrated into everyday life. There is also evidence of emotional attachments to smartphones, as well as experiences of separation anxiety, with descriptions of both psychological and physiological symptoms resulting from smartphone separation (Clayton, Leshner, & Almond, 2015; Thorsteinsson & Page, 2014). Montag and Walla's (2016) exploration of the impact on wellbeing pays specific attention to the risk of damage to social functioning. It is reasoned that digital devices are unable to meet our needs in terms of social and emotional interactions and argued that skills in these areas are likely to be "lost" if not used. The emotional attachments being formed with smartphones may be to the detriment of other important attachment relationships.

In summary, the potential negative impacts of smartphone use (on social connectedness; isolation and loneliness; academic achievement and productivity; risky behaviour; sleep; and mental health difficulties) are of great concern as usage increases. These potential negative consequences highlight the need for awareness to be raised and early intervention for problematic smartphone use to be considered. The importance of intervention is further emphasised when we consider the continued development of technology and the ability to increase addictive properties.

1.3   A review of the literature exploring possible intervention for problematic smartphone use

There is preliminary evidence that students are ready and willing to make changes to their digital use (Genova et al., 2016), and that they are interested in being supported to regulate it (Ali, Jiang, Phalp, Muir, & Mcalaney, 2015). Furthermore, Genova et al.'s (2016) survey suggested that a smartphone application to support management of such difficulties may be an acceptable intervention. A review of digital approaches to problematic smartphone use found that apps existed to track usage and support people to moderate their use, but that none of these had been evaluated (van Velthoven et al., 2018). A review of eHealth interventions for problematic internet use found that these had the potential to be effective, if based upon relevant theory (Lam & Lam, 2016). This finding is consistent with a review providing support for the use of phone based interventions in health promotion (i.e. weight management, smoking cessation) (Cole-Lewis & Kershaw, 2010). Whilst there may be some concerns about using smartphones as the vehicle for intervening in problematic smartphone use, it is important to remember that the aim is controlled or regulated use, rather than abstinence, as might be expected in some substance misuse interventions.

The intervention in the present study was designed to be delivered via a smartphone application (Phone Life Balance, 3.5.1.1 & 3.6.1.1), which has the capability of monitoring phone use and delivering messages to users. This delivery method allows for an intervention that can be automated, wide-reaching, and light touch - all necessary for early intervention. As such, the subsequent literature is considered in relation to this mode of delivery.

Given the relative recency of smartphones and identification of associated problems, the literature relating to intervention is limited. In light on the limited literature specific to problematic smartphone use intervention, the broader literature was also drawn upon in order to identify interventions that may be efficacious. A search conducted in January 2020 resulted in only five papers evaluating interventions for problematic smartphone use, unfortunately, three were unavailable in English. The remaining two papers found

preliminary evidence for a group mindfulness-based cognitive-behavioural intervention (Lan et al., 2018), and a monitoring application through which users could compare their usage to that of others (Ko et al., 2015).

The mindfulness-based cognitive-behavioural intervention group resulted in significant improvements in scores on a measure of phone addiction and in overall screen time for a group of Chinese students (when the intervention group were compared to controls) (Lan et al., 2018). The findings from this study are promising, but preliminary, and provide no insight into the mechanism of change.

The Ko et al. study (2015) reported some improvement in problematic smartphone use resulting from using the monitoring app alone, but the significance of this was unclear. The focus of the study was to compare the monitoring app alone with use of the monitoring app in a group. Greater improvements were found in problematic smartphone use in the group condition, where there was the addition of social comparison and competition. Group intervention was beyond the scope of the present study, and the capability of the application being used.

Students have been found to be of the view that users are often unaware that their digital use has become problematic, possibly due to heavy usage being common (particularly within the student population) (Turner, Bewick, Summers, & Bryant, 2016). Similarly, a survey revealed that users were more likely to identify others (e.g. their children or partners) as using their phones too much, than to identify themselves as doing so (Lee, 2018). This was an important consideration for the present study; it highlighted the importance of bringing problematic usage into awareness.

Considering treatment for internet addiction, the most common are CBT and medication, both of which show preliminary evidence of effectiveness, with CBT appearing more effective than other psychological interventions (Winkler et al., 2013). Young (2011) proposed a model of Cognitive Behavioural Therapy for Internet Addiction (CBT-IA). She proposed three stages: (1) behaviour therapy to manage an individual's time online and offline, (2) cognitive therapy to address maladaptive cognitions that may trigger or maintain problematic internet use and (3) harm reduction therapy to address any co-existing factors, supporting recovery and relapse prevention. An evaluation of CBT-IA found that most participants were able to fully manage their symptoms following 12 treatment sessions, although it was acknowledged that further research was needed to explore longer term effects of the intervention (Young, 2013). As the current research focused on developing a light-touch digital intervention for problematic smartphone use (rather than addiction per se), the CBT-IA protocol could not be used in its full form, but it did inform intervention

development. As will be discussed in more detail, the current intervention drew upon the behavioural ideas suggested as part of CBT-IA (see 1.4.3).

Suggestions have been made that intervention for digital addiction should take into account the individual's perspective on the problem, these perspectives have been found to vary in students (Turner et al., 2016). Billieux and colleagues (2015) criticised the use of the standardised addiction model for treatment of problematic smartphone use, as it targets symptoms (i.e. focuses on reducing problem behaviour), rather than causes. They present a case example; a client who presented with problematic phone use, alongside other psychological difficulties. The case is used to illustrate the potential benefits of offering a formulation-based approach for problematic phone use. The individual presented in their case study was seeking therapy for other reasons, not primarily for problematic phone use. Although a formulation-based approach may be beneficial, at present there is insufficient research to determine whether or not standardised interventions may be effective for managing problematic phone use.

There is evidence that individuals tend to turn to their phones at times of stress (Panova & Lleras, 2016), suggesting that smartphones may be used as an emotional coping or experiential avoidance strategy. This brings to light two possible hypotheses about an individual's mobile phone use – one where the use itself is the problem, and one where usage is secondary to another difficulty. It is unclear whether these presentations would require different intervention.

The importance of not relying on pre-existing models and treatment protocols for other addictions, that may not be the most relevant in this area, has been highlighted (Billieux et al., 2015). This is also supported by the findings detailed by Turner and colleagues (2016); suggesting a somewhat personalised approach may be beneficial, based upon the development of an understanding of usage.

Cole-Lewis and Kershaw's (2010) review emphasised that the strongest evidence for phone-based intervention came from those that were theoretically informed. The current study utilised theoretically informed techniques and interventions, drawing upon literature from and beyond traditional addiction models. The following section will outline the evidence drawn upon to design an intervention that included: goal setting, personalised feedback, and behavioural and mindfulness techniques.

1.4 A review of the literature that informed the design of the current intervention

1.4.1 Goal setting

Goal setting has long been understood to improve outcomes in psychotherapy (LaFerriere & Calsyn, 1978). Goal setting theory postulates that goals influence behaviour though directing attention, energising and increasing persistence (Locke & Latham, 2002); this theory can be usefully applied to addiction (Webb, Sniehotta, & Michie, 2010). As such, goal setting is recommended in the treatment of internet addiction (Young, 1999) and problematic video gaming (King, Delfabbro, & Griffiths, 2010), consistent with CBT protocols for other disorders. Goals also support the consideration of an individual's priorities for intervention; allowing for a somewhat personalised approach to be taken, as previously suggested (Billieux et al., 2015; Turner et al., 2016). Psychotherapy research suggests that approach goals (i.e. to achieve a positive end goal) result in more favourable outcomes than avoidance goals (i.e. to move away from a current unwanted state) (Wollburg & Braukhaus, 2010).

The present research incorporated goal setting, based upon the theoretical understanding that this would have a positive influence upon behaviour change. There was also consideration that these goals could be used to review participant progress towards a change that was meaningful to them (Law & Jacob, 2015). As the study focused on reducing problematic phone use (an avoidance goal), goals related to this were identified, however, participants were also asked to identify an area of their life they wanted to improve alongside this (an approach goal). The goals were also used to inform the intervention messages the participants received (personalisation of the intervention).

1.4.2 Personalised feedback

The Stages of Change model identifies awareness of problem behaviour as a necessary step for change, and feedback has been identified as key to maintaining health behaviour change (DiClemente, Marinilli, Singh, & Bellino, 2001). Considering what can be learnt from other research areas, there is evidence to suggest that feedback through digital technology can disrupt and change habitual behaviour (Hermsen, Frost, Renes, & Kerkhof, 2016). Additionally, there is evidence for efficacy within the student population for change in other problematic behaviours, such as alcohol intake (Bewick et al., 2010).

Comparisons have been made between digital media use and other harmful behaviours, such as smoking, where the use of warning messages (relating to the potential for harmful effects) has been enforced (Ali et al., 2015). It was suggested that similar might be used within

digital media; Ali and colleagues reported the results of their survey completed by 72 students, asking for their views on the use of such warning messages. The survey described different warning messages that could be sent and sought responders' opinions on these. Of those who responded, 86% agreed that receiving information about the amount of time they had spent online would be useful, and 56% thought it would be of use to know the frequency of their checking/visits. Other important factors identified by some interviewees were that messages should not be overly-repetitive or overly-negative, and that the recipient should have some level of control over the messages (e.g. frequency). The overall message from this research is that these messages have the potential to be accepted, and perceived as useful, by a student population.

The intervention in the present research incorporated personalised feedback; this was informed by theoretical understanding and the evidence linking feedback to behaviour change within other problem behaviours. This was also supported by the research findings suggesting UK students were in favour of this intervention for reducing problematic smartphone usage (Ali et al., 2015).

1.4.3   Behavioural intervention

Drawing upon the literature for internet addiction; there is evidence that CBT is an effective treatment for problematic use of technology (Du, Jiang, & Vance, 2010; Young, 2007, 2013). Additionally, there is preliminary evidence that CBT may be effective in reducing problematic smartphone use (Lan et al., 2018). As detailed earlier, the first stage in the CBT-IA protocol (Young, 2011) is behaviour therapy to support management of on- and off-line time. Within clinical guidance (e.g. NICE guidance), behavioural interventions are recommended as the first-line treatment, this fits with the stepped care model of offering the least burdensome intervention first (NICE, 2011).

Chamberlain et al. (2016) report that managing "high-risk triggers" and encouraging adaptive behaviours are important in managing behavioural addictions. Habit formation research identifies the importance of contextual cues as triggers for habitual behaviour (Wood & Neal, 2007). There is evidence of this theory being true for smartphone users; whereby users consistently started using their phones during the same situations (e.g. whilst waiting for a bus), as well as in response to particular emotional states (Oulasvirta et al., 2012). This suggests a benefit of smartphone users being aware of their triggers, and of introducing alternative responses to these.

The almost infinite nature of the online world is an important consideration in understanding smartphone behaviour. A situational or emotional trigger may cause somebody to initiate smartphone use, as described above, but they may then get lost in the online world. An

attempt has been made to identify the rules people may use to decide when to stop searching for information online (Browne et al., 2007). An example of a stopping rule for online searching was: *once no new information is being gained*. Rules such as these may be relevant to some aspects of smartphone use, given that we know smartphones are used to search for information. Other uses may not have such overt rules (e.g. scrolling on social media), perhaps suggesting that an external cue is necessary to cease use (e.g. a time frame, a particular activity). The behavioural intervention designed as part of the current intervention paid attention to how the use of these cues could be encouraged.

Urges and habits have been identified as problematic for smartphone users. Elements of Dialectical Behaviour Therapy (DBT; Linehan, 2014) were designed to target harmful urges and habits. DBT suggests practical behavioural ideas, such as distraction (see 1.4.4 for further use of DBT ideas). Distraction can be operationalised via alternative activities being suggested, an idea endorsed by some of the participants in Ali and colleagues' study (2015) in relation to reducing smartphone use. This idea is consistent with internet addiction literature, which emphasises the importance of introducing or increasing offline behaviours, as well as reducing online interaction (Young, 2010).

Given that some uses of smartphones are positive, and important to their users, abstinence is not a viable option. Retaining controlled use for legitimate purposes is suggested for internet addiction (Young, 2010), and the same is necessary for smartphones. As such, the focus of the behavioural intervention is to better manage or reduce usage.

Overall, the literature provides evidence for behavioural intervention, focused on reducing problem behaviour and increasing alternative behaviour, for problematic technology use. Further, the understanding of problematic smartphone use gained from the literature was used to inform the content of the behavioural messages.

1.4.4 Mindfulness

The nature of the difficulties discussed in relation to problematic smartphone use, such as lack of connectedness, distraction, and semitasking, suggest that individuals' attention is often split between the online world and the offline world, which links to elements of mindfulness, or the opposite (mindlessness). Kabat-Zinn (2003) offers an operational definition of mindfulness: "the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment" (p. 144). The characteristics associated with problematic smartphone use are more similar to mindlessness.

Within Linehan's (2014) DBT programme she suggests that the non-judgemental aspect of mindfulness allows individuals to recognise and consider the consequences of their behaviours. This may in turn lead to effective behaviour change, including behaviours which are impulsive in nature. She suggests that mindfulness may allow for the impact of distractions to be lessened. This perhaps suggests that the distractions caused by smartphone notifications whilst engaging with another task could be better managed through mindfulness.

A recent review suggested that mindfulness is an effective intervention for behavioural addictions (Garland & Howard, 2018). Examples of where it has been effective are gambling (Shonin, Van Gordon, & Griffiths, 2014) and substance misuse (Li, Howard, Garland, Mcgovern, & Lazar, 2017). Associations have been found between increased levels of mindfulness and lower levels of problematic internet use; suggesting that mindfulness may act as a protective factor against it (Calvete, Gámez-Guadix, & Cortazar, 2017; Gámez-Guadix & Calvete, 2016).

Kabat-Zinn (2005, cited in Feldman, Greeson, Renna, & Robbins-Monteith, 2011) has proposed that mindfulness may reduce the over-reliance on mobile technology, he theorises that the use of such devices separates individuals from their immediate experiences. One study, using student self-report data, has revealed a negative correlation between mindfulness and problematic smartphone use (Elhai, Levine, O'Brien, & Armour, 2018). A negative correlation was also found in a study examining mindfulness and texting whilst driving (an example of a behaviour associated with problematic smartphone use), in which they conclude mindfulness-based intervention may reduce this dangerous behaviour (Feldman et al., 2011). These results were corroborated by Terry and Terry (2015), who identified that whilst using phones while driving increased the risk of accidents, increased awareness and acceptance reduced this risk. Further, mindfulness was found to moderate the relationship between mental health problems and problematic smartphone use; a stronger positive relationship was seen for those with lower levels of mindfulness (Yang, Zhou, Liu, & Fan, 2019).

Mindfulness may also have indirect benefits; it has been found to be influential in behaviour change. The Theory of Planned Behaviour suggests that intentions can be used to accurately predict actual behaviour (Ajzen, 1991), and mindfulness has been found to moderate the relationship between intention to change and actual behaviour (Chatzisarantis & Hagger, 2007). In addition to this, Chatzisarantis & Hagger's (2007) study showed that problematic behaviour (in this case, binge drinking) was less likely to prevent engagement with an alternative behaviour in individuals with higher levels of mindfulness. This suggests that

mindfulness may facilitate engagement with other interventions, as well as having benefits as a stand-alone intervention.

Overall the literature suggests that mindfulness has a role to play in behavioural change, and that it is a potentially effective intervention in addiction treatment. The exploration of problematic smartphone use also suggests links between characteristics of problematic phone use and the mechanisms underlying mindfulness. This indicated possible benefits of including mindfulness in the current intervention.

1.5 Summary

The increasing reliance upon technology, and most commonly, smartphones, has been identified. Students have been recognised as being at particular risk for developing problematic smartphone use. Some of the possible consequences of problematic smartphone use for students have been outlined, highlighting the need for early intervention. The possible consequences drawn from the literature are: reduced social connectedness; isolation and loneliness; a reduction in academic achievement and productivity; poor sleep quality; risky behaviour; and mental health difficulties.

This review considered behaviour change theories, as well as the literature relating to problematic technology use and other problem behaviours or addictions. This informed the development of a light-touch digital intervention for problematic smartphone use. Given the format of the intervention and its delivery, the following were included as distinct phases: goal setting, personalised feedback, mindfulness techniques, and behavioural suggestions.

2 Aims

The main aim of the research was to evaluate the acceptability and effectiveness of a light-touch digital intervention designed to reduce problematic smartphone use in undergraduate students. As well as measuring problematic smartphone use, the study explored changes in mindfulness, wellbeing, psychological distress and sleep across the intervention.

The following hypotheses were explored:

1. The intervention package will reduce problematic smartphone use
2. Mindfulness will increase as smartphone use becomes less problematic
3. Wellbeing will improve as smartphone use becomes less problematic
4. Psychological distress will reduce as smartphone use becomes less problematic
5. Sleep will improve alongside the improvements in wellbeing and reductions in problematic smartphone use

3   Method

3.1   Design

A mixed-methods systematic case series design was used to investigate the impact of an intervention for problematic smartphone use. A case series follows the design of single-case research; however, the results are considered collectively to inform the discussion and conclusions. Single case research allows for the collection of rich data on both process and outcome during an intervention, which supports the understanding of a participant's change process throughout the study (Elliott, 2002). This method supports an exploration of change mechanisms and any causal relationship between intervention and outcome. As each participant acts as their own control, confounding variables relating to differences between participants are controlled for (Morley, 2018). The study aimed for ten complete data sets, in line with guidance on case-series design (Morley, 2018).

Within the current research multiple sources were used to collect data (direct measures, self-report measures and an interview), providing a variety of data types. Data was collected at regular time points, increasing the ability to determine causes of change (Morley, 2018). The use of a change interview allowed exploration of causal inferences made by participants as they were given the opportunity to reflect on perceived change and possible attributions (Elliott, 1999).

The current research included an assessment phase (baseline), intervention phases, and then a follow-up phase, after which the change interview was administered. The mindfulness and behavioural intervention phases were randomised for the first ten participants recruited. The final three participants were replacements, the intervention was therefore delivered in the order that had been randomised for the participants they replaced.

3.2   Ethical considerations

This study was reviewed and approved by the School of Medicine Research Ethics Committee, University of Leeds (see Appendix A).

In the unlikely event that participants became distressed, all participants had been provided with signposting information to the university's support services within the participant information (see Appendix B). In addition to this, where participants indicated psychological distress, this was discussed at the end of the change interview, and specific signposting

information was provided. Participants were informed that confidentiality would be broken if significant risks were identified, although this was not necessary during the study.

All of the data collected during the study was anonymised in order to maintain confidentiality. Online Survey was the only place where identifiable data was collected, which is fully compliant with all UK data protection laws and satisfies the University of Leeds requirement for data storage and encryption of research data. All downloaded electronic data was stored on the University's M drive, which is password protected, and unique identifiers were used for each participant.

3.3 Context

The study was undertaken at the University of Leeds; technology use is commonplace within the university. The university uses a virtual learning environment, communicates with students via online communications, and uses a smartphone app for students to access timetables, emails, and other practical information (e.g. maps, computer availability).

The university has a wellbeing support service, they offer both practical and emotional support to students who wish to access it. The service does not offer any specific interventions for problematic use of technology.

At the time of writing, due to the restrictions in place to manage the COVID-19 outbreak, educational institutions were entirely reliant on online interaction with their students, and many of us were reliant on the internet for social interaction. The final three participants recruited to this study were participating at the time of the outbreak.

3.4 Participants and recruitment

A convenience sample of undergraduate students from the University of Leeds was recruited to the case series. Undergraduate students were invited to complete a recruitment survey, which was advertised via posters in communal areas and emails sent to those on opt-in mailing lists (students who had opted in to receiving information about research studies) (see Appendix E). Potential participants were provided with a minimum of 48 hours to consider their participation.

Recruitment adverts directed students to an Online Survey link, where they were first presented with the participant information, and then invited to consent to participation (see Appendix B.1 & Appendix B.2). This information and consent form related to the recruitment survey, and also provided a very brief summary of the intervention study. This

summary supported participants to decide whether they wanted to opt-in to being contacted about further participation if eligible. Once consent had been provided, participants went on to complete the survey itself. Those who completed all survey questions and measures were given the option to be entered into a prize draw (prizes: 1 x £20 gift voucher; 1 x £10 gift voucher). The recruitment survey was completed by 74 participants in total; a summary of the demographic details of all respondents can be seen in Table 1.

Table 1: Recruitment survey respondent demographics

Demographic	Value	%
Gender	Female	71.2
	Male	24.7
	Trans*	1.4
	Prefer not to say	2.7
Faculty of Study	Arts, Humanities and Cultures	20.3
	Biological Sciences	10.8
	Business	5.4
	Engineering and Physical Sciences	16.2
	Environment	9.5
	Medicine and Health	27
	Social Sciences	10.8
Age	18-21	64.9
	22-25	20.4
	26-29	9.5
	30-33	4.2
	…	
	57-61	1.4
Ethnicity	Asian/Asian British	12.2
	Black/ African/Caribbean/Black British	6.8
	Mixed/Multiple ethnic groups	1.4
	Other ethnic group	4.1
	White	73
	Prefer not to say	2.7

Participants were selected based upon the inclusion criteria (outlined in Table 2), those who were eligible and had opted-in to being contacted after completing the recruitment survey were invited to participate in the intervention. Participants were contacted via email and invited to read the participant information pertaining to the intervention part of the study and to provide consent if they wished to do so (see Appendix B.3 & Appendix B.4). A minimum of two weeks was given to participants to consider their participation (although they were

able to opt-in sooner if they chose). Ten participants were included in the final analysis, the recruitment procedure can be seen in Figure 1.

Table 2: Case series inclusion/exclusion criteria

Inclusion criteria	Exclusion criteria
Current undergraduate student	Not currently an undergraduate student
Problematic online use, indicated by scores >30 on the modified Internet Addiction Test (see 3.5 for more detail).	Not presenting with problematic online use
Contemplating change, indicated by survey questions based on the stages of change model (Prochaska & Norcross, 2001) (see Appendix D)	Indicated that they do not wish to make changes to their smartphone/online usage.
Android smartphone user (due to the capability of the application being used for the study)	Not using an Android smartphone as their primary device

Participants who consented to enrol in the case series were invited to a meeting where the study outline was explained in person and questions could be addressed. All participants reconfirmed their consent verbally during this meeting. Once any questions had been answered and consent had been confirmed, Phone Life Balance (the smartphone monitoring app, 3.5.1.1 & 3.6.1.1) was downloaded on their phone with all relevant permissions, and the FitBit (sleep and activity monitoring watch, 3.5.1.2) was set up with a dummy email address. The dummy email addresses allowed for data to be collected remotely as the account could be logged in to by the research team without using personal details.

Financial reimbursement was given to those who participated in the case series. Varying levels of reimbursement was given, dependent upon the duration of engagement and amount of completed data (up to a maximum of £30, or a voucher of equivalent value). Final payment was given to participants once their participation had ended (either through withdrawal or completion).

In order to be eligible for the reimbursement for phases 1-4 (see Figure 2) participants were required to have given the app permission to gather data for a minimum of four days out of seven within the given phase and to have completed the associated measures.
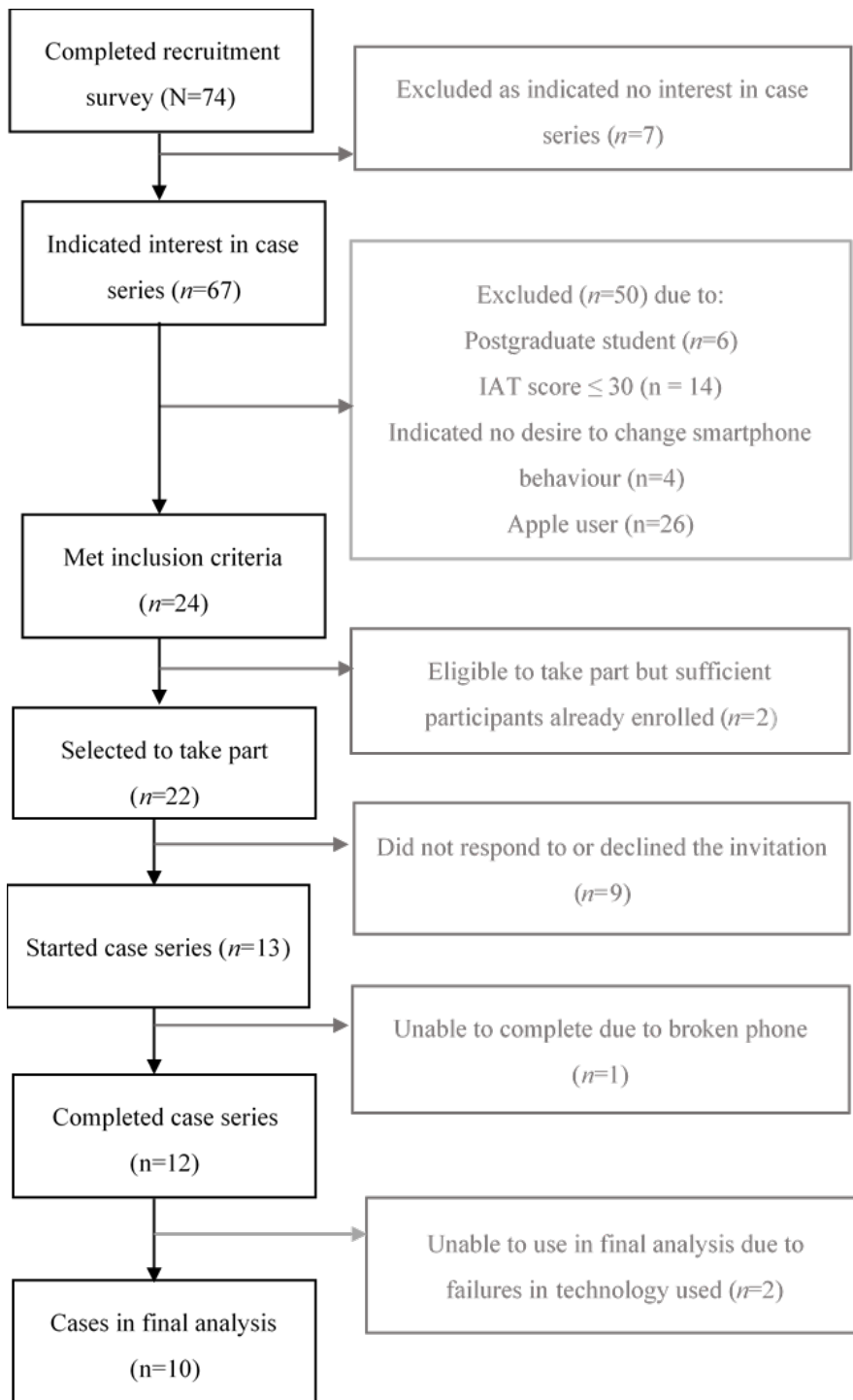
Figure 1: Recruitment procedure

3.5 Measurement

Measurement consisted of direct, objective measurement, self-report measures, participant feedback on the intervention, and qualitative data via interview. Problematic smartphone use, mindfulness, wellbeing, psychological distress, self-determination and sleep were

measured across the intervention. Both problematic smartphone use and sleep were measured through both direct and self-report measurement. Each method and tool of measurement is detailed below.

3.5.1 Direct measurement

3.5.1.1 Phone Life Balance (smartphone application)

Phone Life Balance is an Android smartphone application which collects phone use data and allows for messages to be sent to the user. Once Phone Life Balance had been installed on a participant's phone it recorded every application they used and the duration for which they used it. Phone Life Balance had features that protected the privacy of participants – for example, the application did not collect data relating to the content of participants' interactions with their phone. This means that what they were doing on a certain app (such as websites accessed within an internet browser) or any messages/posts they were writing (on social media, for example) were not recorded. The application recorded the time an app was opened and closed. The data was synchronised to an online platform at regular intervals, which could be accessed only by the research team. Participants were not able to access their own data usage statistics during the study. The application is also capable of being used to send personalised messages; this was used to send the intervention messages to participants (see 3.6.1.1).

The application had technical limitations that impacted the quality of the data collected. There were brief periods in the early stages of the study where data was lost for all enrolled participants (see dates under *app issue* heading in Table 3). Two participants changed their smartphone device part way through the study, also resulting in lost data (see dates under *phone issue* heading in Table 3). The recording of phone unlocks by Phone Life Balance was determined to be unreliable (see Limitations for further explanation), and as such this data was not included in analysis.

3.5.1.2 FitBit Charge 2 (activity watch)

The FitBit Charge 2 is a wrist-worn activity watch that tracks activity, heartrate and sleep. Participants were asked to wear the FitBit as much as they were able in order to ensure data was regularly collected and synchronised with the online dashboard. Data was then downloaded from the online dashboard by the research team. Only the sleep data was used for analysis in the present research.

Some of the FitBit data was unfortunately lost and the reasons for this could not always be determined (see Table 3 for dates of lost data). There were times participants forgot to wear

or charge the device, there were other times where it appeared the device failed to synchronise with the database.

Table 3: Missing data for each participant (participants listed in order of study enrolment)

Participant	Dates of missing data		
	Phone Life Balance		**FitBit**
	App issue	Phone issue	
Teal	7/10/19 – 10/11/19 13/11/19	26/10/19 – 27/10/19	5/11/19 – 8/11/19 19/11/19 – 20/11/19
Blue	7/10/19 – 10/11/19 13/11/19		17/12/19 21/12/19 29/12/19
Lilac	13/11/19		03/01/20 06/01/20
Purple			06/01/20
Green			16/01/20 – 03/02/20
Pink	Phone broken; lost data exceeded study limits – withdrawn from study		
Yellow			23/01/20 25/01/20 - 26/01/20
Red			10/01/20 21/01/20 - 22/01/20
Orange			06/01/20 11/01/20 13/01/20 - 14/01/20 25/01/20
Grey			05/02/20
Silver			20/02/20 06/03/20 10/03/20 27/03/20
Peach		14/02/20 – 17/02/20	
Lime			09/02/20 11/02/20 – 16/02/20 18/02/20 – 21/02/20 23/02/20 20/03/20 24/03/20 24/04/20

3.5.2 Self-report measures

The outcome measures collected were used both to establish suitability for case series participation and to monitor change and outcome. The following were measured: problematic usage of smartphones and the online world, mindfulness, wellbeing and psychological distress, self-determination and sleep. The measures used within the study are detailed below; the schedule for measurement can be seen in Figure 2.

3.5.2.1 Problematic usage of smartphones and the online world

3.5.2.1.1 Mobile Phone Problem Use Scale (MPPUS)

The MPPUS (Appendix C.1) is a 27-item scale that uses a 10-point Likert scale to measure the extent to which an individual's phone use is problematic. A high level of internal consistency has been found, along with a moderately strong positive correlation with self-reported time spent using a mobile phone (Bianchi & Phillips, 2005). There are no cut-off scores published for this measure. Reliable change was calculated using the scores calculated by Bianchi and Phillips; reliability = 0.93 and standard deviation = 31.6.

3.5.2.1.2 Internet Addiction Test (IAT), modified

The IAT (Appendix C.2) is a measure of the severity of an individual's dependency on the online world, which was first developed in 1998 (Young, 1998a, 1998b). The IAT consists of 20 items and is scored on a 6-point Likert scale. The language used in this measure is a reflection of the time it was developed and was therefore modified for the purposes of this study. The language modifications did not change the meaning of the items but allowed for changes in how the online world is now accessed, referring to the "online world" as opposed to "the internet", which some people may only associate with computer use. For example, "How often do you block out disturbing thoughts about your life with soothing thoughts of the internet?", was changed to: "How often do you block out disturbing thoughts about your life with soothing thoughts of the online world?". In addition, extra examples were added to some questions to reflect the way the online world is now used. For example, "How often do you check your e-mail before something else that you need to do?", was edited to include social media (e.g. Facebook, WhatsApp, Snapchat, Twitter), as well as email.

The following categories of online dependency were identified by the developer (Young, 2010):

- 0 – 30 = Normal;
- 31 – 49 = Mild;
- 50 – 79 = Moderate;
- 80 – 100 = Severe.

These cut-off scores were used to determine suitability for participation in the case series, whereby the inclusion criteria required a score indicative of at least mild dependency (i.e. >30).

A meta-analysis of the IAT's reliability (Frangos, Frangos, & Sotiropoulos, 2012) computed an overall Cronbach's alpha of 0.89, which was used for calculating reliable change. The

standard deviation used for analysis was 13.87, which is taken from a University of Leeds population (Esmaielian Khyabani, n.d.).

3.5.2.2 Mindfulness

3.5.2.2.1 The Mindful Attention Awareness Scale (MAAS)

The MAAS (Appendix C.3) is a 15-item measure scored on a 6-point Likert scale. It has been shown to be a valid measure of mindfulness (MacKillop & Anderson, 2007). It is not a clinical measure and accordingly there are no cut-off scores. A reliability of 0.87 and a standard deviation of 0.68 have been calculated (Brown & Ryan, 2003); these were used to calculate reliable change in the present study.

3.5.2.3 Wellbeing and psychological distress

3.5.2.3.1 The Warwick Edinburgh Mental Wellbeing Scale (WEMWBS)

The WEMWBS (Appendix C.4) is a 14-item measure of mental wellbeing, designed for use within the general population, which has been shown to have good psychometric properties (Tennant et al., 2007). Each item is scored on a 5-point Likert scale.

There are no cut-offs for this measure, given that wellbeing is not a clinical concept. Norms taken from a student population were used to calculate reliable change within the present research. Cronbach's alpha for the student population = 0.89, and the standard deviation = 8.71.

3.5.2.3.2 The Short Warwick Edinburgh Mental Wellbeing Scale (SWEMWBS)

A short version of the WEMWEBS was also used as a between-phase measure within this study. The SWEMWBS (Appendix C.5) uses seven items from the full measure. It is also scored on a 5-point Likert scale, and good psychometric properties have been demonstrated (Stewart-Brown et al., 2009).

3.5.2.3.3 Clinical Outcomes Routine Evaluation Outcome Measure (CORE-OM)

The CORE-OM (Appendix C.6) is a 34-item measure of psychological distress covering four dimensions: subjective well-being; problems/symptoms; life functioning; and risk/harm. The CORE-OM has been shown to have good psychometric properties (Evans et al., 2002). The measure is scored on a 5-point Likert scale. A mean item score can be used, allowing for interpretation where items are missing.

A clinical cut-off score of 10 has been calculated (Barkham, Mellor-Clark, Connell, & Cahill, 2006; Connell et al., 2007). Connell et al. calculated a reliable change index of 3.6 using data from the general population and 5.9 from the clinical sample. Given that the study recruited from a student population, the general population figure was used.

3.5.2.4 Self-determination

3.5.2.4.1 Basic Psychological Need Satisfaction Scale (BPNSS) – in General

The BPNSS (Appendix C.7) is a 21-item scale measuring need satisfaction in general in one's life, using three subscales of: competence, autonomy, and relatedness (Deci & Ryan, 2000; Gagné, 2003). Competence relates to a sense of effectiveness and mastery; autonomy to a sense of volition and psychological freedom; and relatedness to a sense of intimacy and connection with others.

Self-determination has been positively associated with successful behaviour change, and autonomy appears to be critical for change within psychotherapy (Ryan & Deci, 2008). Self-determination is suggested to be impaired in individuals with an addiction; such that they are not following their own commands (Schlimme, 2010). The BPNSS may aid understanding of behaviour change in the present study.

3.5.2.5 Sleep

3.5.2.5.1 BIOLSCREEN

The BIOLSCREEN (Appendix C.8) is a measure used to identify sleep problems (Stallman, 2017). This measure does not generate a score; however, it does determine an individual's perception of their sleep/sleep difficulties and the frequency and duration of any problems. This measure added context to the sleep data obtained via the FitBits, as well as providing a back-up measure, should the FitBit data not have been reliably recorded.

3.5.2.6 Self-identified goals

3.5.2.6.1 Goal Based Outcomes (GBO)

Goal Based Outcomes measure an individual's progress towards any goal(s) they have identified by using a 0-10 rating scale (10 indicating the goal has been fully achieved), that can be re-evaluated at any given time point (Law & Jacob, 2015). Participants in the present study were asked to rate their progress towards their goals (i.e. please select the number that best describes how close you are to reaching your goal).

3.5.2.7 **Daily measure**

Throughout phases 3, 4 & 5 of the case series, participants were asked to complete a daily 6-item measure developed specifically for the study.

The measure used five items from the other measures used in the study and one item relating to smartphone use. Participants were asked to indicate to what extent they agreed with each statement using a 5-point scale ("Strongly Disagree", "Disagree", "Neither Agree not Disagree", "Agree", "Strongly Agree").

The items are listed below, along with the measures from which they were taken, where appropriate.

1. I felt close to other people (WEMWBS)
2. I felt unhappy (CORE-OM)
3. I found it difficult to stay focused on what was happening in the present (MAAS)
4. I felt a sense of accomplishment from what I did (BPNSS)
5. I had difficulty getting to sleep or staying asleep (CORE-OM)
6. I felt in control of my smartphone use

The rationale for this measure was to track change at regular intervals, whilst ensuring that it was short and quick enough to not deter participants from continued engagement.

3.5.3 **Additional information and qualitative data**

3.5.3.1 **Participant intervention utilisation and evaluation**

At the end of each phase where participants received messages they were asked questions to evaluate their utilisation and experience of the messages they were receiving. Following the feedback messages phase participants were asked how many messages they had read, to what extent they had found them useful (on a scale of $0 - 10$), and which specific messages they had found useful. Following the mindfulness and behavioural intervention phases, they were asked how many of the messages they had engaged with, to what extent they had found them useful (on a scale of $0 - 10$), and which ideas they had tried.

3.5.3.2 **Client change interview**

The client change interview (Elliott, 1999) is a semi-structured interview designed to evaluate therapy process and identify changes that have occurred; this was adapted for the present research (Appendix C.9). The interview is designed to explore any changes clients/participants perceive to have occurred, and to what they attribute these changes. The

interview also asks about helpful and unhelpful aspects of the intervention/study. The change interview was used to structure exit interviews with participants and added context to the data obtained via direct measurement and self-report measures. As part of the interview participants were also invited to reflect on the data obtained (i.e. any changes in screen time, or on the outcome measures).
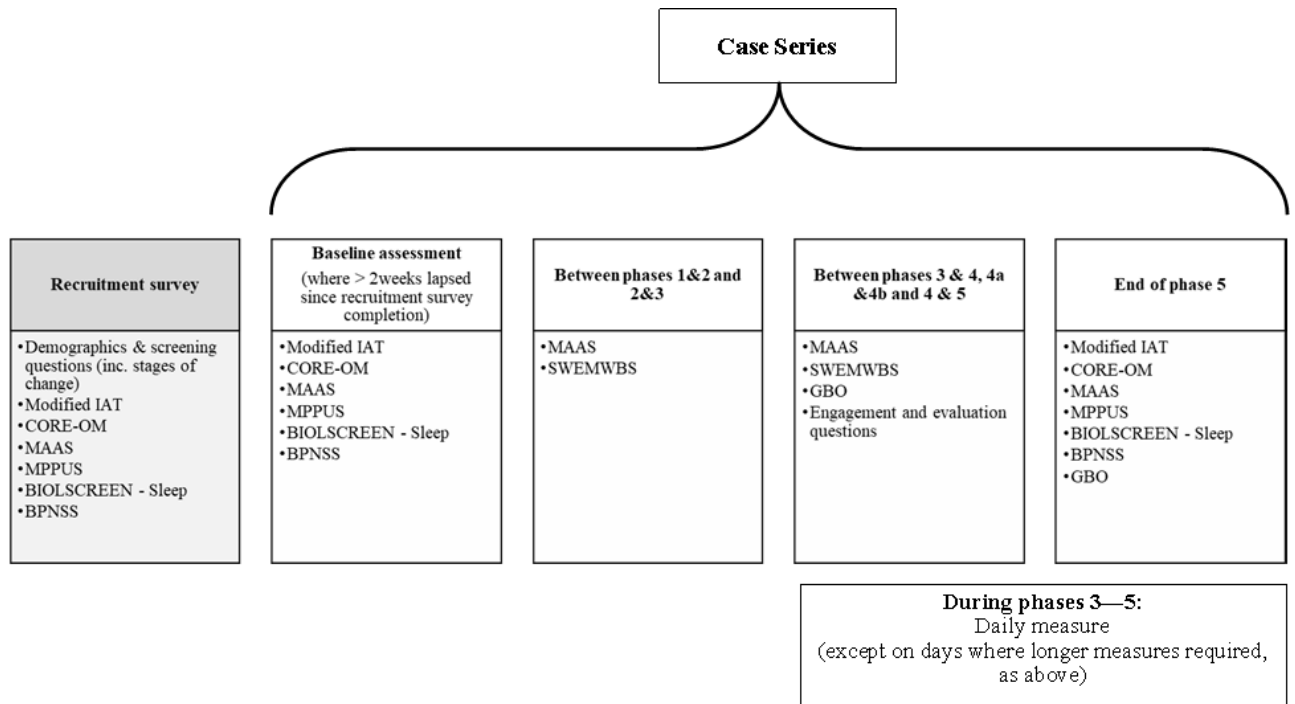
Figure 2: Measurement points (See 3.5 for full titles and descriptions)

3.6 Procedure

3.6.1 Delivery

3.6.1.1 Phone Life Balance (smartphone application)

The intervention messages sent as part of the study were delivered via Phone Life Balance for most participants. Phone Life Balance allows text to be sent to users, as well as embedded links to external sources (e.g. videos on YouTube or images uploaded to file sharing services).

3.6.1.2 WhatsApp (smartphone application)

WhatsApp is a smartphone messaging application. For the two participants where message delivery via Phone Life Balance was not possible (the phone operating system was not

compatible with Phone Life Balance's messaging feature), WhatsApp was used to send the messages, links and images.

3.6.1.3 Online Survey (web based)

All surveys completed as part of the study were completed via Online Survey through a bespoke URL sent to each participant.

3.6.2 Intervention content and associated assessment

3.6.2.1 Survey 1: baseline assessment

If case series participants had completed the recruitment survey within the two weeks prior to enrolment, this was considered to be a baseline measurement. Where more than two weeks had passed between the recruitment survey and commencement of case study participation, participants were asked to complete the survey again in order to ensure an up-to-date baseline assessment - this was necessary for three participants.

The optimum schedule of all subsequent phases is outlined below, which assumes that there were no delays in survey completion or pauses owing to technology downtime. For all surveys up to three reminders were sent on three consecutive days. For the between-phase surveys, the next phase of the study did not commence until the day after survey completion. Schedules for each participant can be seen in the results (4).

3.6.2.2 Phase 1: monitoring (days 1- 14)

At the beginning of the study the Phone Life Balance app was installed on participants' phones, and the FitBit was set up to record data. The intention during this two week period was to gather data that represented participants' usual sleep and smartphone use patterns. No outcome measures were requested during this phase, with consideration that regular outcome measures may act as an ongoing reminder of study participation, and thus have a greater influence on behaviour than monitoring alone. The Phone Life Balance and FitBit monitoring continued for the duration of the study (after the final survey had been completed and all data downloaded, participants were invited to delete the apps).

3.6.2.3 Survey 2 (day 15)

Following the two weeks of monitoring participants completed an online survey. Participants were asked to complete the Mindful Attention Awareness Scale (MAAS) and the Short Warwick Edinburgh Mental Wellbeing Scale (SWEMWBS). As phone use and

sleep were measured directly, no outcome measures relating to these variables were completed.

3.6.2.4 Phase 2: goal setting (days 16 - 22)

Participants were invited to set goals; this was done via Online Survey. The survey set out goal options for participants to choose from relating to their smartphone use (e.g. "reduce the amount of time I spend on an app", "be less distracted by my smartphone"). A second goal was identified relating to improvement of other behaviours as a result of better managing smartphone use (e.g. studying, family relationships). Participants could also select "other" and use a free text box for both goals. For the second goal, once participants had selected an area they would like to improve, they were asked to identify a specific goal in this area. For both goals participants were asked to rate how close they were to achieving this so that this could be monitored throughout the study (see 3.5.2.6.1). Participants were given one week to complete this task, and it was required for progression on to the next phase of the study.

3.6.2.5 Survey 3 (day 23)

As Survey 2: the MAAS and the SWEMWBS were completed.

3.6.2.6 Ongoing measurement during phases 3, 4 & 5 (day 24 – end)

From this point onwards (until the final survey was completed) participants were asked to complete a daily survey. The daily measure (3.5.2.7) consisted of six items linking to the key outcomes being measured throughout the study (on days where participants were asked to complete longer surveys, these replaced the daily measure, participants were not asked to complete both).

3.6.2.7 Phase 3: feedback messages sent (days 24 – 30)

Participants received personalised messages relating to the information gathered about their smartphone use during the previous phases, and their ongoing use within this phase. The planned messages related to the following (see Appendix F.1 for all example messages):

- Average daily screen time and an indication of what this would be over a year (e.g. *You spend 3 hours a day on your phone, over a year this would be over 45 whole days.*).
- Percentage of waking day spent on phone and a pie chart illustrating this (waking hours based on FitBit data)
- Number of unlocks (e.g. *You unlock your phone up to 100 times a day.*)

- Most used apps (pie chart showing how the four most used apps compare to one another)
- Amount of time spent on most used app over the last month
- Feedback based on that day (e.g. *This morning you have spent 2 hours on your phone and unlocked it 45 times.*)
- A summary of the month (a bar chart showing average daily screen time for weeks 1 – 4)

Some messages did have to be adapted slightly. For some participants unlocks were not recorded, and synchronising was not happening as regularly as intended, this meant that the messages relating to unlocks and the feedback based on that day could not be sent. For these participants alternative messages were sent relating to the total number of times they opened a frequently used app on their phone in one day and the most amount of time spent on their phone in a single day.

3.6.2.8 Survey 4 (day 31)

As survey 2 (MAAS and SWEMWBS), plus additional questions. Specifically, participants were asked to: re-rate how close they were to achieving each of their two goals, state how many of the messages received they had read/engaged with, to rate how useful they had found them (on a scale of 0-10), and to then list which messages they had found useful.

3.6.2.9 Phase 4

The order of the two intervention components detailed below as phase 4a and phase 4b was randomised. Randomisation was planned to allow for consideration of which (if either) of these interventions had a greater impact upon smartphone use, or whether the order of the interventions appeared to determine outcome.

3.6.2.10 Phase 4a: behavioural intervention (days 32 – 38 / days 40-46)

Participants received a message each day with a suggestion to change their behaviour in relation to phone use. The messages were informed by the literature and personalised based upon each participant's smartphone use data and goals. Each message provided a direct suggestion to reduce smartphone use, including the following (see Appendix F.2 for all example messages):

- Reducing/turning off notifications (e.g. *Try turning off notifications for Instagram.*)

- Turning phone off/placing it out of sight during specific activities (e.g. Y*ou said that leisure time is important to you. Plan an activity, whilst doing this set your phone to "do not disturb" and place it out of sight.*)
- Setting phone-free windows of time (e.g. *Stop using your phone 30 minutes before you go to bed, do something else to wind down in this time.*)
- Resisting urges to pick up the phone (e.g. W*henever you feel like you want to check your phone, delay it by 15 minutes, spend this time doing another activity.*)

3.6.2.11 Survey 5 (day 39)

As survey 4 (MAAS, SWEMWBS, goal-based outcomes, feedback on messages received).

3.6.2.12 Phase 4b: mindfulness intervention (days 32 – 38 / days 40-46)

Each day participants received a message with a suggestion of a mindful activity/brief mindfulness exercise. A list of the suggestions made is provided below (n.b. some of the examples have been shortened, see Appendix F.3 for full versions):

- Awareness of the present moment using the senses (*Pause for a moment and notice: 5 things you can see, 4 things you can feel, 3 things you can hear, 2 things you can smell, 1 thing you can taste*)
- Mindfulness of everyday activity (*Pick an everyday activity and focus all of your attention on this activity while you do it. Your mind might wander but bring it back to the activity. You can use your senses like the activity yesterday.*)
- Mindfulness of the breath (audio via video link)
- Mindfulness during a pleasurable activity (*Pick an activity that you really enjoy (this might be listening to your favourite music, or doing something creative) and be sure to engage with it fully and give it all of your attention. If your mind wanders, notice this and bring it back to the activity.*)
- Mindfulness during physical activity (*Do a physical activity and focus your attention whilst you do it, this could be a walk or something more strenuous. You might notice things around you, or what is going on in your body, either or both would be okay.*)
- Mindful eating (*Really focus your attention on something you eat today. Try not to do anything else whilst you are eating. Again, use all of your senses.*)
- Noticing thoughts (audio via video link)

3.6.2.13 **Survey 6 (day 47)**

As survey 4 (MAAS, SWEMWBS, goal-based outcomes, feedback on messages received).

3.6.2.14 **Phase 5: consolidation and continued monitoring (days 48 - 61)**

No direct suggestions were made during this phase. Participants were invited to continue with the skills and strategies gained from the previous phases.

3.6.2.15 **Survey 7: final survey (day 62)**

The final online survey included a repeat of the full battery of outcome measures, as administered prior to the intervention, along with the goal-based outcome measure.

3.6.2.16 **Change interview**

Once all phases of the study and associated assessments were completed participants were invited to attend a semi-structured interview.

3.7 Analysis

The survey data was imported into SPSS, which was used to calculate all scale and subscale scores. The data recorded via Phone Life Balance and FitBit was imported in to Microsoft Excel. Microsoft Excel was used to create graphical representation of the data for all participants.

The reliable change criteria for each standardised measure was calculated using an online calculator, based upon the figures previously detailed (3.5). Published clinical cut-off scores were used where available.

Visual analysis of the graphs was carried out to identify changes between phases and over the course of the study (Morley, 2018). The medians and interquartile ranges were calculated for the screen time data for each phase to enable comparisons.

In order to answer the research questions the visual analysis and reliable change analysis were used alongside the data obtained during the change interviews.

4   Results

In total ten participants completed the study. Participants were undergraduate students aged between 18 and 31, with a gender ratio of 9:1 (female: male), they were all white European and varied in relation to school and year of study (see Table 4).

The individual findings for each participant are presented here, followed by the group analysis.

Table 4: Participant demographics

Participant Pseudonym	Age	Gender	School of Study	Undergraduate Year of Study	Ethnicity
Teal	22	Female	Dentistry	5	White British
Lilac	31	Female	Healthcare	3	White British
Purple	24	Female	Languages, Cultures and Societies	3	White European
Yellow	18	Female	Civil Engineering	1	White British
Orange	21	Female	Languages, Cultures and Societies	3	White European
Red	19	Female	Computing	2	White British
Grey	21	Male	Mechanical Engineering	Temporary leave after finishing 2nd year	White European
Silver	20	Female	Fine Art, History of Art and Cultural Studies	2	White European
Peach	21	Female	Chemistry	4	White British
Lime	20	Female	Education	3	White British

4.1   Participant one: Teal

Teal is a 22-year-old white British female, she is in her fifth year of studying dentistry. In the recruitment survey she reported that the amount of time she spends on her phone had not changed in the last twelve months, that she had previously tried unsuccessfully to cut down

the time she spends on her phone, and that she was sure she spent more time on her phone than she should.

During the change interview Teal was asked to reflect on her reasons for participating in the study, she said that making changes to her smartphone use was something she had been meaning to do but had struggled with motivation for. She described using her smartphone as something that was easy (i.e. sitting and scrolling requires less effort than other tasks) but that she would prefer to do something more productive. She had wondered if her phone use was habitual or if her phone was a 'safety blanket'. She explained that she had tried replacing her smartphone use with other activities, but that this had never been sustained.

Teal scored within the mild range for dependence on the online world (as measured by the IAT) and scored below the clinical cut-off for psychological distress (as measured by the CORE-OM). The recruitment survey asked whether participants had problems with sleep in general, Teal selected no. However, when the survey asked more specific questions, she did say that she had had problems with getting to sleep, waking during the night or too early, and feeling tired/unrested in the morning.

Teal was randomly allocated to complete the mindfulness phase followed by the behavioural phase.

Table 5: Teal pre-post measure scores

Measure	Pre	Post	Pre - Post	Direction of Change
MPPUS	134	81	53	Reliable Improvement
IAT	40[a]	32[a]	8	Improvement
MAAS	4.2	5.4	-1.2	Reliable Improvement
WEMWBS	54	57	-3	Improvement
CORE-OM	3.8	3.8	0	No Change
BPNSS: Autonomy	28	27	1	Deterioration
BPNSS: Competence	33	38	-5	Improvement
BPNSS: Relatedness	43	43	0	No Change

n.b. reliable indicates that the reliable change criteria was met
[a] mild

4.1.1 Engagement

Teal reported that she had read all seven of the feedback messages and rated their usefulness 9/10. She reported trying four of the seven mindfulness suggestions and rated their usefulness 7/10. Of the behavioural suggestions she reported trying five of the seven and rated their usefulness 8/10. During the change interview Teal explained that she sometimes forgot to try the suggestions, especially if she received the message whilst busy (e.g. at university). Teal completed 72% of the daily measures.

4.1.2 Smartphone usage

The amount of time Teal spent on her phone each day is presented in Figure 3. Overall, there was little difference between time spent on her smartphone from the start to the end of the study and comparison of median screen time across the phases of the study shows little change. The interquartile ranges show that the variation in Teal's screen time increased in the mindfulness and behavioural phases, however the missing data in the mindfulness phase makes this difficult to interpret. There is one day in the behavioural phase where screen time appears increased; Teal had recently changed phones. During the change interview Teal expressed disappointment that there had not been a reduction in the amount of time she was spending on her phone.
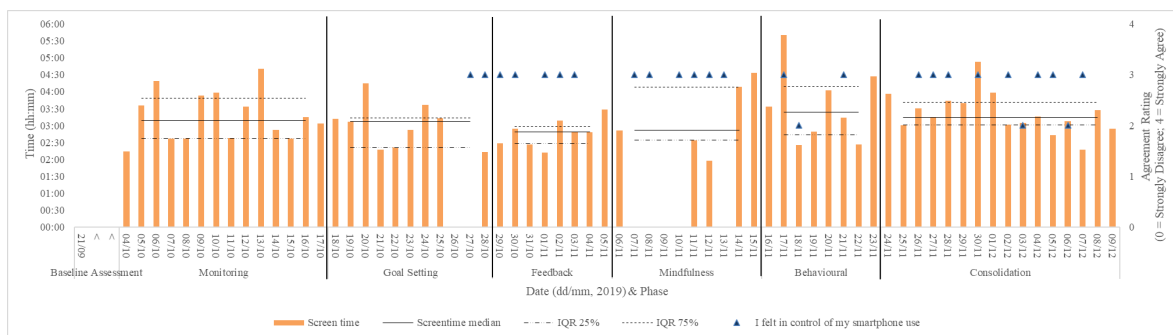
Figure 3: Teal daily screen time and daily measure (I felt in control of my smartphone use) rating

As Figure 3 shows, Teal did not report much variation in the amount of control she felt she had over her smartphone use throughout the duration of the study. The MPPUS and the IAT, however, did show improvements, although only the change on the MPPUS met the reliability criteria (see Table 5).

On balance, although there is no clear change in the amount of time Teal is spending on her phone, there is evidence that there has been an improvement in her problematic use, as measured by the MPPUS. This improvement in problematic use is corroborated by qualitative data gathered during the change interview (4.1.8).

4.1.3 Mindfulness

As shown in Table 5, Teal's mindfulness (as measured by the MAAS) showed a reliable increase over the course of the study. Figure 4 demonstrates that the MAAS ratings improved over the goal setting (this increase was reliable) and feedback phases, rather than in response to the mindfulness phase.
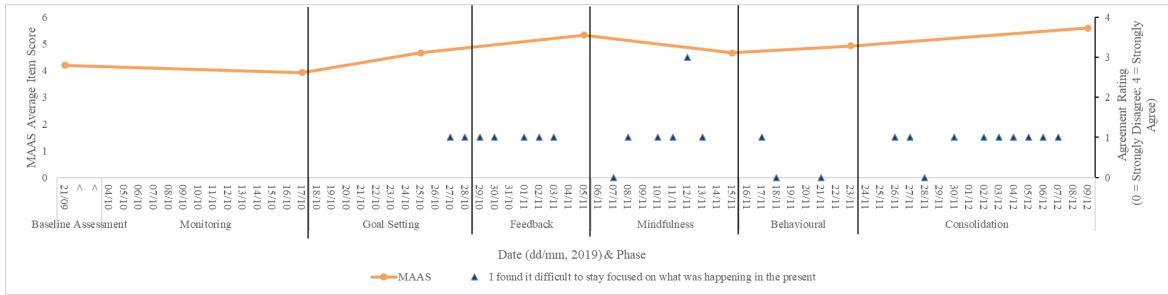
Figure 4: Teal MAAS and daily measure (I found it difficult to stay focused on what was happening in the present) rating

4.1.4   Wellbeing and psychological distress

As can be seen from the SWEMWBS (Figure 5), there was little variation in Teal's self-reporting of wellbeing. The WEMWBS showed a small increase for Teal between the start and the end of the study, this did not meet the criteria for reliable change (see Table 5). There was no change in Teal's score on the CORE-OM.

The two daily measures linked to psychological distress and wellbeing did not show much variation. As can be seen from Figure 6 there was one day that Teal reported feeling unhappy (10/11/2019), she also reported feeling closer to others on this day (Figure 7).
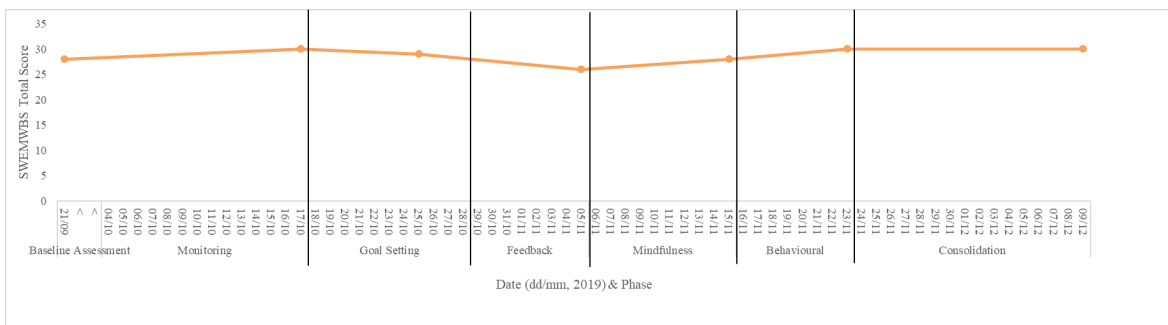
Figure 5: Teal SWEMWS Total Scores
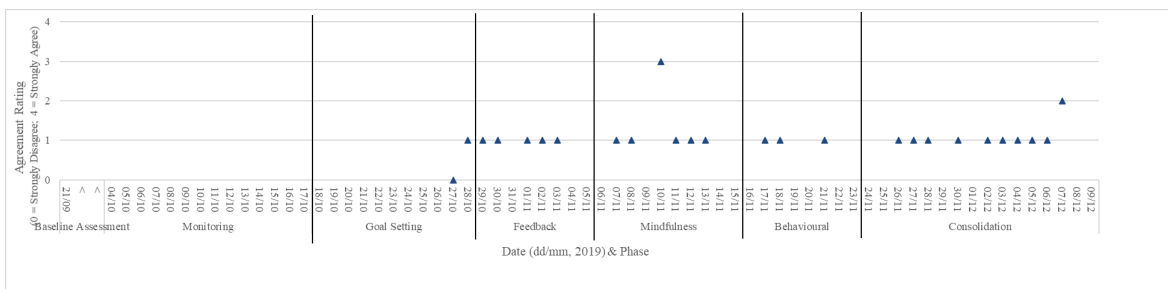
Figure 6: Teal daily measure (I felt unhappy) agreement ratings
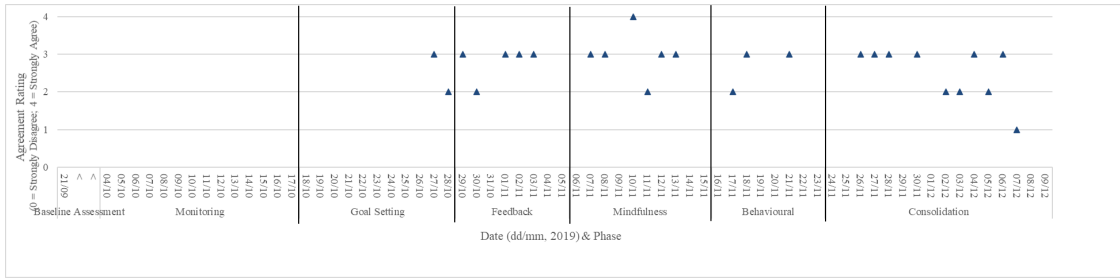
Figure 7: Teal daily measure (I felt close to other people) agreement ratings

4.1.5 Self-determination

The BPNSS competence subscale showed improvement over the course of the study (see Table 5). Figure 8 illustrates that Teal's response to the daily measure (which was taken from the competence subscale of the BPNSS) showed some variation in all phases, with some lower agreement ratings during the final phase of the study.
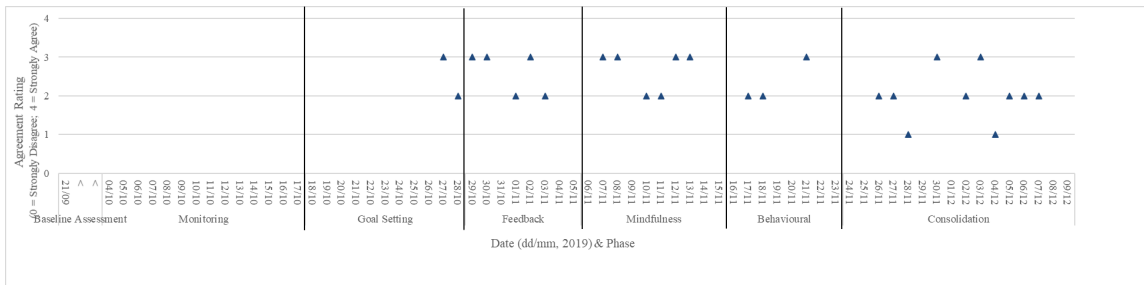
Figure 8: Teal daily measure (I felt a sense of accomplishment from what I did) agreement ratings

4.1.6 Sleep

There was only minimal variation in Teal's sleep duration throughout the study, and relative consistency in the daily measure agreement rating (see Figure 9). This contrasts with self-reported problems getting to sleep at the start of the study, no longer reported at the end.

Figure 9: Teal sleep duration & daily measure agreement rating (I had difficulty getting to or staying asleep)
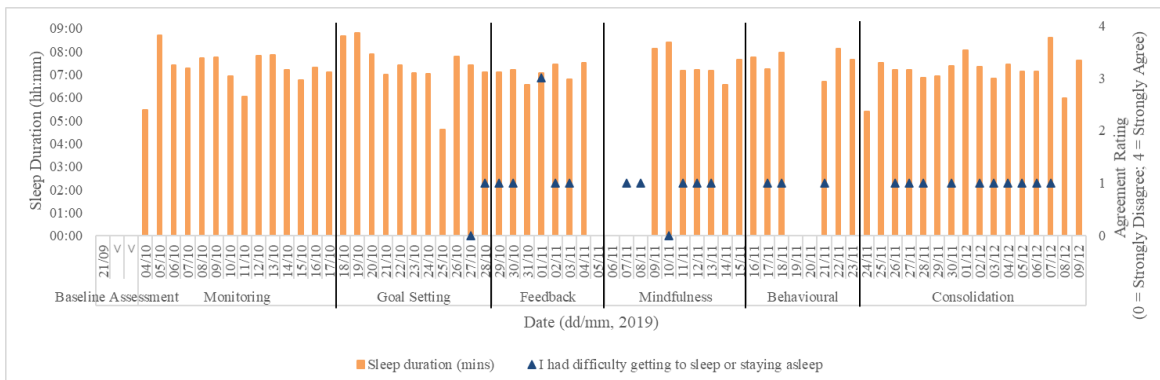
4.1.7 Goals

Visual analysis shows clear improvements in Teal's goals throughout the study, with the biggest improvements being during the feedback and mindfulness phases (see Figure 10). Whilst Teal's achievement rating of her goal to improve sleep and get into the habit of yoga plateaued after these phases, her achievement rating of her goal to be less distracted by her smartphone reduced following the behavioural phase and increased again following the consolidation period.
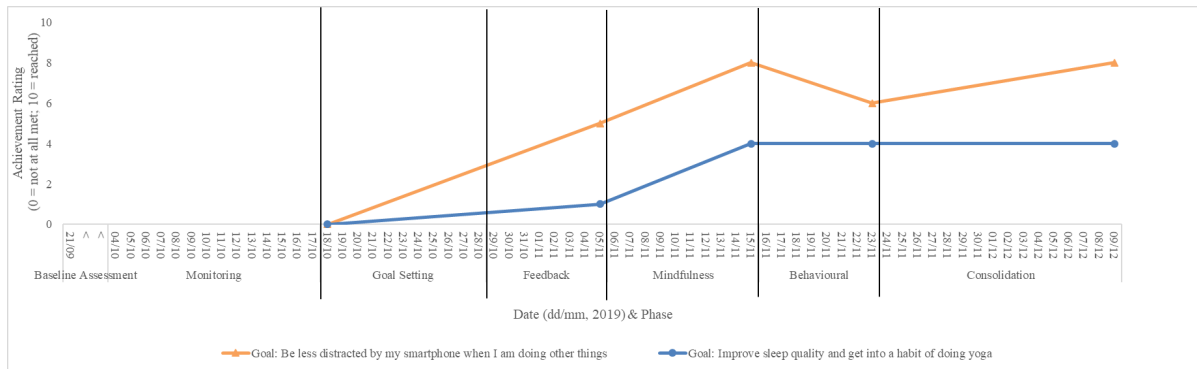
Figure 10: Teal goal achievement ratings

4.1.8 Change interview

Teal described four changes during her study participation, these changes are outlined in Table 6, along with the ratings she gave for expectancy, likelihood and importance. Teal attributed the changes to a combination of the following: (1) the fact that she knew she was being monitored and not wanting to be judged; (2) having to spend time studying for her exams; and (3) the intervention received. She described increased awareness and being forced to acknowledge how much she was using her phone, as well as questioning her reasons for using it. When asked to summarise the most helpful aspects of the study she said: "just giving me that awareness…to be like actually why, why are you going on it now…what, what purpose is it serving you?". She also noted that she had enjoyed being in the moment more, reported finding the feedback encouraging, and said that the suggestions were novel.

Table 6: Changes reported by Teal during interview

Description of change	Expectancy of change	How likely would it have been without the study	Importance of change
Consciously staying off my phone, distracting myself and doing other things where possible	Somewhat expected it	Somewhat unlikely without the study (probably would not have happened)	Very important
Thinking less about my phone	Somewhat surprised by it	Somewhat unlikely without the study (probably would not have happened)	Very important
Having periods where I switch my phone off altogether	Somewhat surprised by it	Very unlikely without the study (clearly would not have happened)	Very important
Being more aware and not being plugged in all the time	Somewhat expected it	Somewhat unlikely without the study (probably would not have happened)	Extremely important

Teal said that she would recommend the intervention to others and that she planned to continue using some of the ideas suggested to her, this included: switching her phone off and/or leaving her phone in another room; trying to engage in a different (relaxing) activity before bed; and being more present during family time.

4.1.9 Conclusion

Overall, there is evidence that Teal's problematic smartphone use has reduced. Although Teal's screen time has not reduced, it appears that she is using her phone in a different way. Teal reported clear progress towards achieving the goals she outlined in the study. The key changes reported by Teal relate to being able to separate herself from her phone, either physically or cognitively (or both), and this having a positive impact upon important areas of her life (e.g. relaxation and family time). There is also evidence of an overall increase in mindfulness, which links closely with the changes in smartphone use described (being present during activities, not being distracted by her phone).

4.2 Participant two: Lilac

Lilac is a 31-year-old white British female; she is in her third year of studying midwifery. In the recruitment survey she reported that the amount of time she spends on her phone had increased in the previous twelve months, that she had thought about cutting down the time she spends on her phone, and that she was sure she spent more time on her phone than she should.

During the change interview Lilac was asked to reflect on her reasons for participating in the study, she reflected on "being on it all the time" (her phone) and struggling to be separated from it. She spoke about using her phone to escape from difficult feelings (e.g. feeling down or stressed). In the past Lilac has tried not using her phone as much, or not going on certain games, but said that this would only last a few hours, until she became bored or stressed and used it again.

Lilac's baseline assessment indicated moderate dependence on the online world (as measured by the IAT) and she scored above the clinical cut-off for psychological distress (as measured by the CORE-OM). When Lilac was asked in the recruitment survey whether she had problems with sleep in general, she selected yes and reported sleep difficulties for around two years.

Lilac was randomly allocated to complete the behavioural phase followed by the mindfulness phase.

Table 7: Lilac pre-post measure scores

Measure	Pre	Post	Pre - Post	Direction of Change
MPPUS	138	104	34	Reliable Improvement
IAT	61[b]	48[a]	13	Reliable Improvement
MAAS	2.6	4.5	-1.9	Reliable Improvement
WEMWBS	22	43	-21	Reliable Improvement
CORE-OM	25.3[c]	13.8[c]	11.5	Reliable Improvement
BPNSS: Autonomy	21	18	3	Deterioration
BPNSS: Competence	20	18	2	Deterioration
BPNSS: Relatedness	28	39	-11	Improvement

n.b. reliable indicates that the reliable change criteria was met
[a] mild
[b] moderate
[c] above clinical cut-off

4.2.1 Engagement

Lilac reported that she had read six of the seven feedback messages and rated their usefulness 8/10. She reported trying three of the seven behavioural suggestions and rated

their usefulness 6/10. Of the mindfulness suggestions she reported trying two of the seven and rated their usefulness 8/10. Lilac completed 77% of the daily measures.

4.2.2   Smartphone usage

Lilac's daily screen time fluctuated; based on the medians there is an overall reduction between the start and the end of the study (see Figure 11). The final phase (consolidation) shows the smallest interquartile range, indicating less dispersion of scores during this phase. There is a clear reduction in screen time between 18/12/19 and 23/12/19, this was the start of the Christmas holiday period, where Lilac returned home to her husband and children. The figure also shows that Lilac reports feeling more in control of her phone use quite consistently from the end of the behavioural intervention phase.
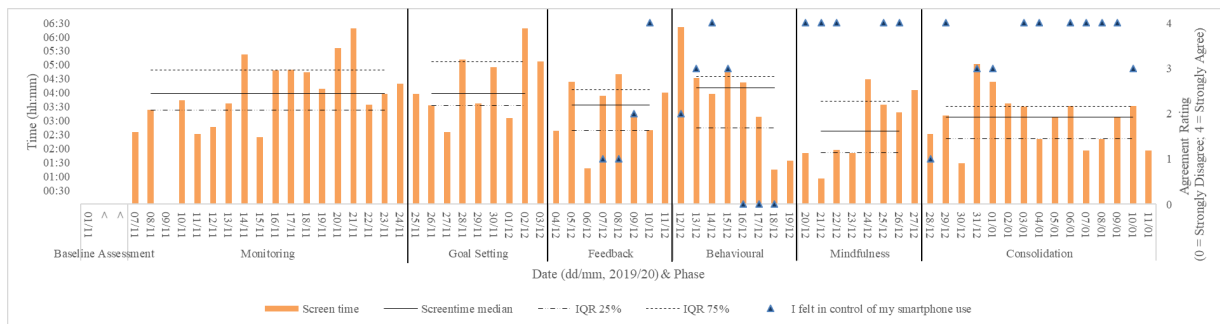
Figure 11: Lilac daily screen time and daily measure (I felt in control of my smartphone use) rating

The MPPUS and the IAT both demonstrated a reliable decrease over the course of the study (see Table 7); indicating a reduction in problematic phone use and online dependency, this change was explored during the change interview (4.2.8).

Overall, the results suggest a small decrease in daily screen time, as well as reliable improvements on the measures of problematic use, with Lilac feeling more consistently in control of her smartphone use as the study progressed. This conclusion is further supported by qualitative data collected during the change interview (4.2.8).

4.2.3   Mindfulness

Lilac showed a reliable increase in self-reported mindfulness over the course of the study (see Table 7); this change occurred during the consolidation period of the study (see Figure 12). The daily reports of mindfulness are variable (see Figure 12).
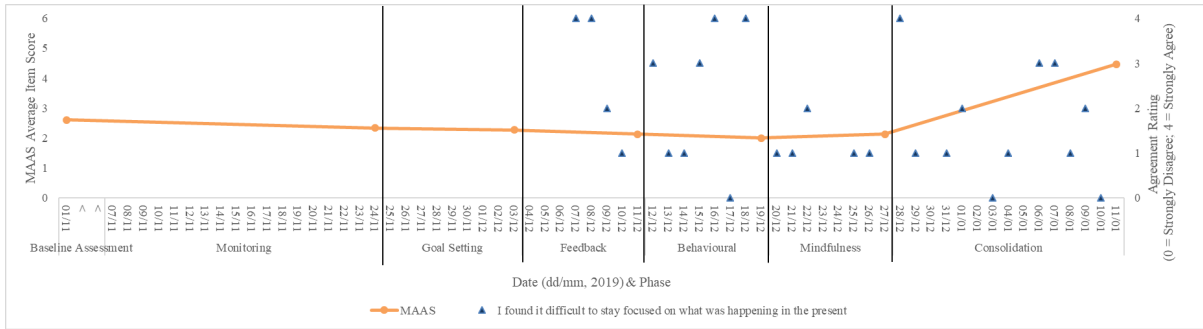
Figure 12: Lilac MAAS and daily measure (I found it difficult to stay focused on what was happening in the present) rating

4.2.4 Wellbeing and psychological distress

The SWEMWBS showed an increase in self-reported wellbeing between the end of the mindfulness phase and the end of the consolidation phase (see Figure 13). The full WEMWBS showed a reliable increase between the start and end of participation (see Table 7). The CORE-OM also showed a reliable reduction over the course of Lilac's participation; her final score remained above the clinical cut-off (see Table 7).

The daily measures showed variation throughout (see Figure 14 & Figure 15), although there does appear to be an overall reduction in Lilac's agreement with the item: "I felt unhappy".
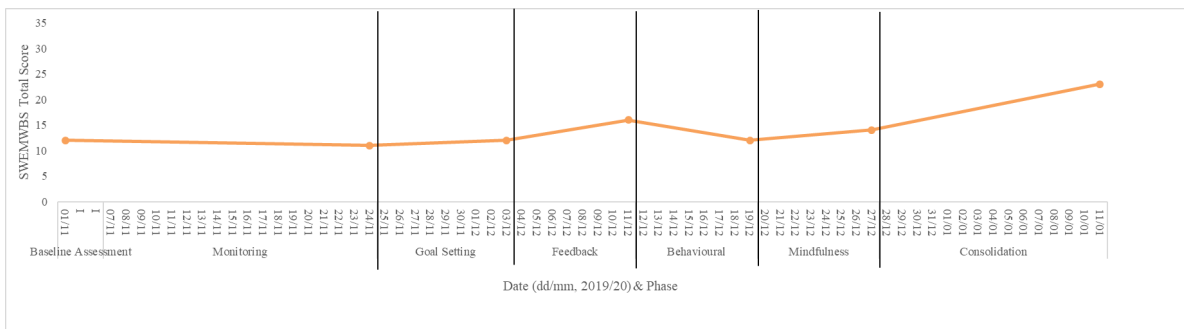
Figure 13: Lilac SWEMWS Total Scores
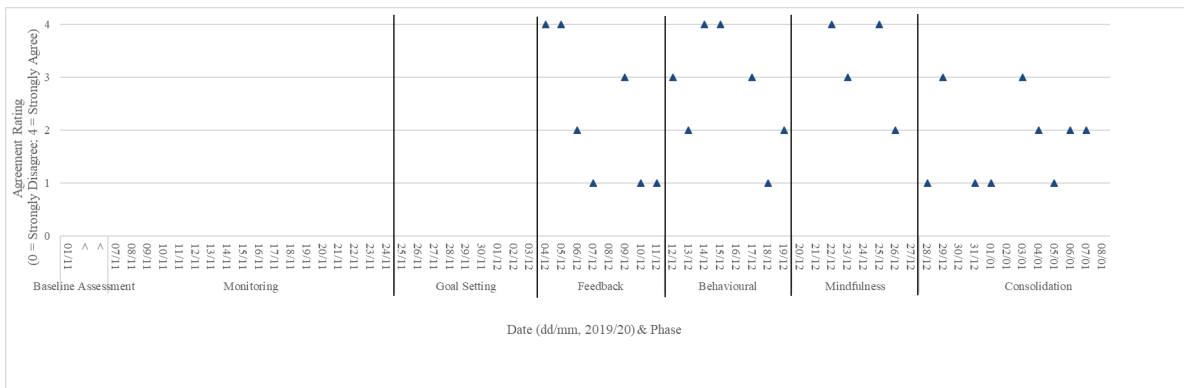
Figure 14: Lilac daily measure (I felt unhappy) agreement ratings

Figure 15: Daily measure (I felt close to other people) agreement ratings

4.2.5 Self-determination

There was an increase in Lilac's BPNSS relatedness subscale score, with small decreases in the other two subscales (autonomy and connectedness) (see Table 7). There is a pattern of increased agreement with the statement "I felt a sense of accomplishment from what I did", *strongly agree* responses are seen only in the final phase (see Figure 16).
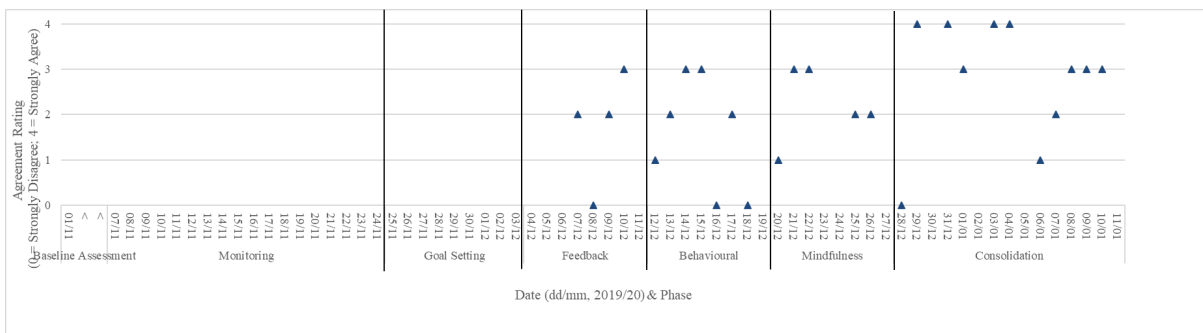
Figure 16: Lilac daily measure (I felt a sense of accomplishment from what I did) agreement ratings

4.2.6 Sleep

Lilac's sleep duration varies, and there is a period of reduced sleep duration around the mindfulness phase (see Figure 17). Lilac reported in her change interview that she found Christmas time particularly stressful, which may have impacted upon her sleep. There are a few lower ratings in Lilac's agreement with "I had difficulty getting to sleep or staying asleep" towards the end of the study. In the final survey Lilac reported continued sleep difficulties, although she reported an improvement during the change interview.
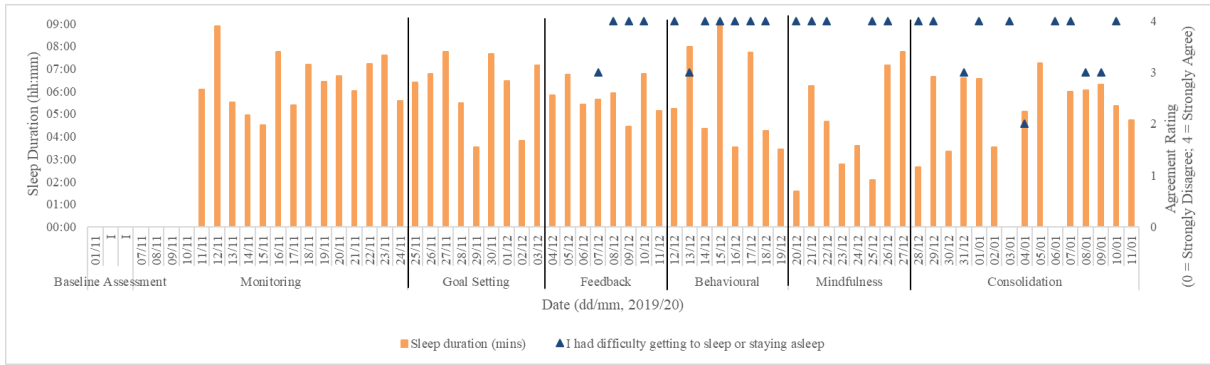
Figure 17: Lilac sleep duration & daily measure agreement rating (I had difficulty getting to or staying asleep)

4.2.7 Goals

Lilac's goal achievement ratings demonstrate improvements in both of her goals throughout the study (see Figure 18). The achievement rating of her goal of reducing the time she spends on her phone increases consistently throughout, whereas the goal of not using her phone around her children reduces following the feedback phase, but then also improves consistently.
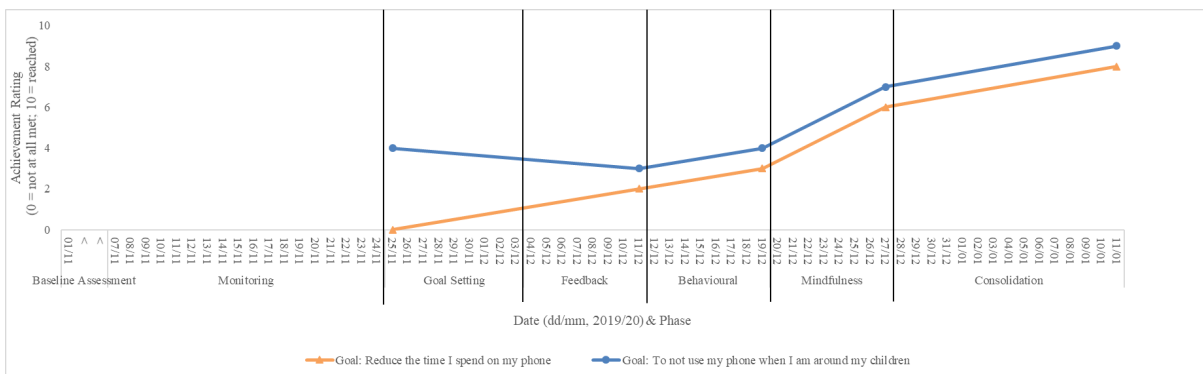
Figure 18: Lilac goal achievement ratings

4.2.8 Change interview

The changes described by Lilac are outlined in Table 8. Lilac spoke of increased awareness of her behaviour facilitating change, and of choosing the times when she would use her phone (when it was not interfering with other activities, such as spending time with her children).

Lilac said that she had found the mindfulness exercises helpful, particularly when stressed, meaning that she could use the exercises instead of reaching for her phone as she previously had. She reflected that this had enabled her to remain in the present whilst managing the panic, rather than "escaping into the phone". She also said that the suggestions for separating from her phone, such as not taking it to bed, were helpful.

Table 8: Changes reported by Lilac during interview

Description of change	Expectancy of change	How likely would it have been without the study	Importance of change
Been a bit happier	Somewhat surprised by it	Somewhat unlikely without the study (probably would not have happened)	Very important
Sleeping better	Very much surprised by it	Very unlikely without the study (clearly would not have happened)	Extremely important
Putting my phone down	Somewhat surprised by it	Somewhat unlikely without the study (probably would not have happened)	Extremely important

Lilac reflected that there had also been an impact of the FitBit data, being able to see her sleep duration highlighted the need for change, which combined with the suggestions facilitated change.

Lilac explained that she had travelled abroad at the start of January, the impact of this trip is unclear.

The data, and in particular the fact that there had been only a small change in recorded screen time, was reflected on during the interview. Lilac responded that the way she was using her phone had changed: "I think I'm definitely using it differently".

Lilac said that she would recommend the intervention to others and that she planned to continue with the mindfulness practice.

4.2.9 Conclusion

There is clear evidence of improvement for Lilac in all areas measured. Both the quantitative measures and qualitative data gathered during the change interview suggest improvements in problematic smartphone use, wellbeing and psychological distress, sleep, and Lilac's self-identified goals. The measures are also indicative of an increase in mindfulness and an improvement in relatedness. The reduction in problematic phone use is linked with using her phone differently, rather than necessarily reducing use. The change interview revealed that

Lilac's phone often served a purpose of enabling her to cope with difficult emotions; learning new strategies with which she could replace this (e.g. mindfulness) seemed to be an important factor. The changes for Lilac appeared mostly during the final phase of the study.

4.3   Participant three: Purple

Purple is a 24-year-old white European female in her third year of study in the School of Languages, Cultures and Societies. In the recruitment survey, she reported that over the previous twelve months the amount of time she spent on her phone had increased. She said that she was sure she spent more time on her phone than she should, and that she thought about cutting down.

During the change interview Purple was invited to reflect on her reasons for participating in the study. She said that the main reason for participating was curiosity, but that she ideally wanted to lower her phone usage. She reflected on the usefulness of her phone, as well as the many time wasting functions it can serve for her. She said "half my life is on my phone" and that she would feel disabled without it, meaning that she was not able to leave the house without it. She felt that she used her phone more than she should, despite acknowledging the negative effects (e.g. losing concentration after checking a message whilst studying). Purple said that she had deleted apps in the past to try to better manage her use, but that she had later reinstalled them. She has her phone on silent, however there is a small light that indicates a new notification on her phone, and she feels uncomfortable if this is not in sight as she feels she might miss something. She said "I get like stressed out when I can't see my phone…like I check it more if it's not in front of me".

The recruitment survey placed Purple within the moderate range for dependence on the online world (as measured by the IAT). She scored above the clinical cut-off for psychological distress (as measured by the CORE-OM). During the change interview Purple said she had realised that she is "not okay", this was brought to her attention when filling out the survey measures, with questions about wellbeing and distress. The recruitment survey asked whether participants had problems with sleep in general, Purple selected *no*. She selected *yes* when asked if she had difficulty getting to sleep and with feeling tired/unrested.

Purple was randomly allocated to complete the behavioural phase followed by the mindfulness phase.

Table 9: Purple pre-post measure scores

Measure	Pre	Post	Pre - Post	Direction of Change
MPPUS	178	142	36	Reliable Improvement
IAT	59[b]	44[a]	15	Reliable Improvement
MAAS	1.67	2	-0.33	Improvement
WEMWBS	38	40	-2	Improvement
CORE-OM	20.9[c]	21.2[c]	-0.3	Deterioration
BPNSS: Autonomy	34	25	9	Deterioration
BPNSS: Competence	30	20	10	Deterioration
BPNSS: Relatedness	38	33	5	Deterioration

n.b. reliable indicates that the reliable change criteria was met
[a] *mild*
[b] *moderate*
[c] *above clinical cut-off*

4.3.1 Engagement

Purple reported that she had read all seven of the feedback messages and rated their usefulness 10/10. She reported trying two of the seven behavioural suggestions and rated their usefulness 8/10. Of the mindfulness suggestions, she reported trying four of the seven and rated their usefulness 6/10. Purple explained that she did not engage with the mindfulness suggestions because she had tried them before and not found them helpful; "like I've done them breathing exercises before; they don't do anything for me", she said that she tried two "to prove again to myself that they don't do anything". She said that the behavioural suggestions were difficult to implement as being away from her phone makes her more aware of it. She also said that she did not receive notifications for all of the messages. The lack of notifications meant that Purple sometimes read four messages on the same day; she chose not to engage with some ideas as a result. Purple completed 65% of the daily measures.

4.3.2 Smartphone usage

The amount of time Purple spent on her phone each day is presented in Figure 19. The graph shows a reduction in smartphone use during the behavioural phase; this increased a little in the two subsequent phases but did not return to levels recorded in the first three phases (the median remained below 3 hours). During the change interview Purple explained that between 30/12/19 and 10/01/20 she had returned to her home country. In her home country she did not have mobile data, which would likely have impacted her phone use.

During the final phase (consolidation) there are some days where Purple strongly agrees with the statement: "I felt in control of my smartphone use", which she had not reported in

previous phases (see Figure 19). This finding is consistent with her report during the change interview: "I don't use it less but I use it more targeted" and "I do feel like I'm getting…more out of it", in that she reported the usefulness of her phone in academic contexts.
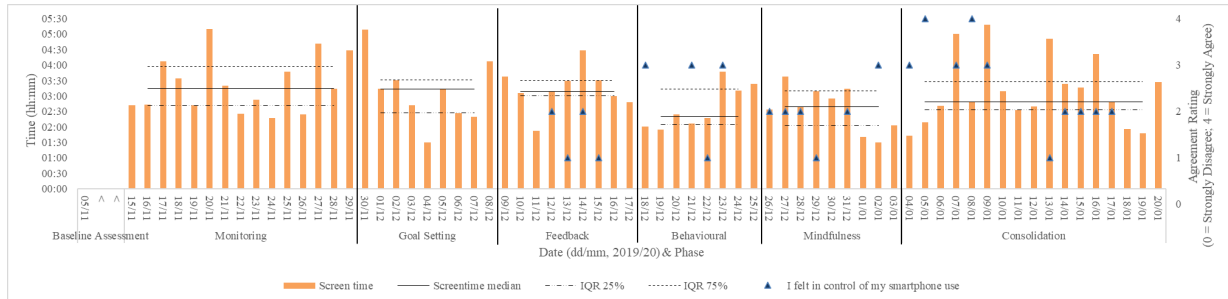
Figure 19: Purple daily screen time and daily measure (I felt in control of my smartphone use) rating

Purple's scores on the MPPUS and the IAT saw a reliable reduction, suggesting an improvement in the level of problematic phone use and dependency on the online world (see Table 9).

Although there was little change in screen time, the differences indicated by the self-report measures provide evidence of a reduction in problematic use, suggestive that there was a change in the way in which Purple is using her phone.

4.3.3 Mindfulness

Purple's MAAS score shows some slight variation over the phases of the study (see Figure 20). Although there was a small increase overall, this was not a reliable change (see Table 9). Variation can be seen in the daily measure of mindfulness, there are more *disagree* and *strongly disagree* responses to "I found it difficult to stay focused on what was happening in the present" during the consolidation period that other phases (Figure 20).
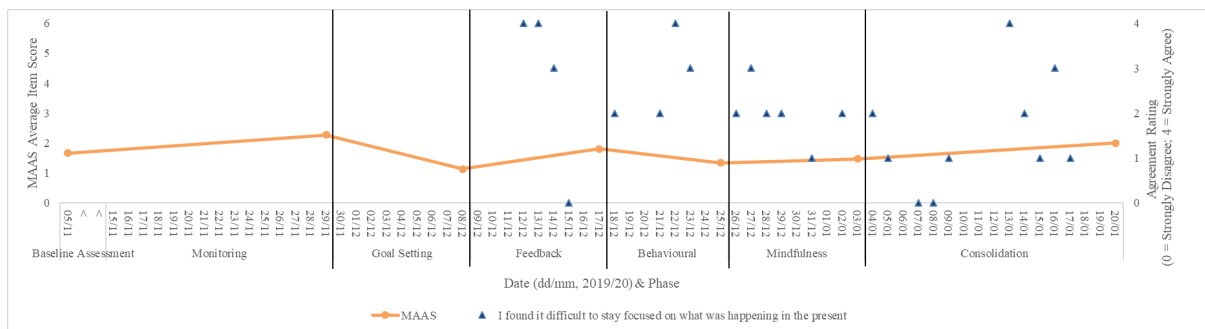
Figure 20: Purple MAAS and daily measure (I found it difficult to stay focused on what was happening in the present) rating

4.3.4 Wellbeing and psychological distress

The SWEMWBS shows little variation in self-reported wellbeing (see Figure 21). The change in the full WEMWBS did not meet the criteria for reliable change, neither did the CORE-OM (Table 9).

The daily measures seen in Figure 22 and Figure 23 show some variation. The *strongly disagree* responses to "I felt unhappy" and *strongly agree* responses to "I felt close to other people" are during the period of time Purple had returned to her home country.
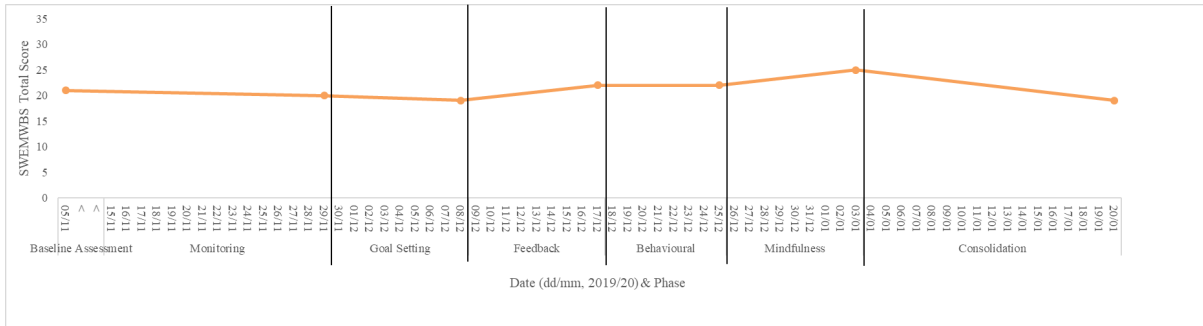
Figure 21: Purple SWEMWS Total Scores

Figure 22: Purple daily measure (I felt unhappy) agreement ratings
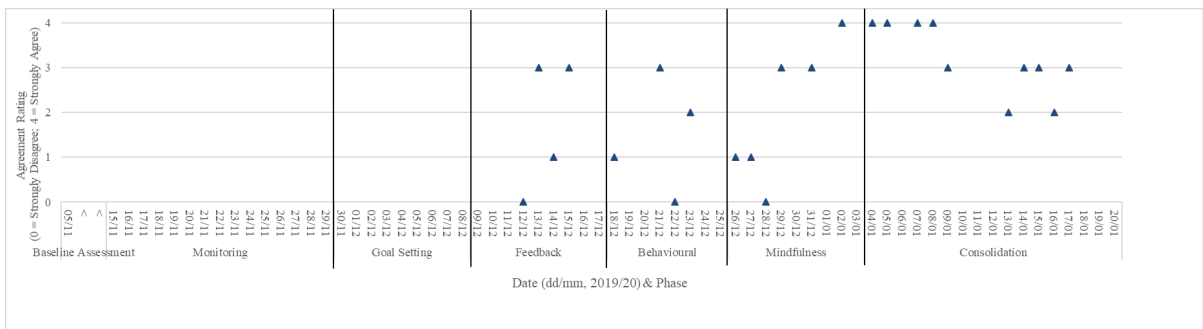
Figure 23: Purple daily measure (I felt close to other people) agreement ratings

4.3.5 Self-determination

The BPNSS showed an overall deterioration, this was seen across all 3 subscales, although greater deterioration in the areas of competence and relatedness (see Table 9). The daily

measure "I felt a sense of accomplishment from what I did" shows variation, with the lowest agreement ratings during the behavioural phase and towards the end of the consolidation phase (see Figure 24).

Figure 24: Purple Daily measure (I felt a sense of accomplishment from what I did) agreement ratings

4.3.6 Sleep

In interpreting Purple's sleep it is important to note that she cited shift-working as a factor impacting upon her sleep. There does not appear to be a clear pattern of change in sleep between the phases (see Figure 25). Her responses to "I had difficulty getting to sleep or staying asleep" also vary throughout. When asked in the final survey if she had problems with sleep, Purple selected *yes* and indicated that these problems had been present for "a few years".
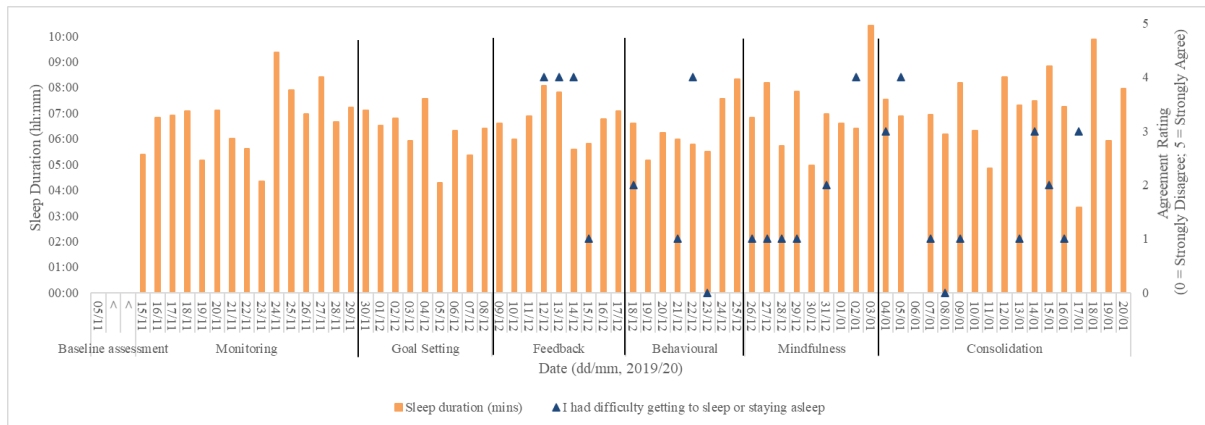
Figure 25: Purple sleep duration & daily measure agreement rating (I had difficulty getting to or staying asleep)

4.3.7 Goals

The goal achievement ratings reported by Purple show improvements (see Figure 26). Achievement ratings for her first goal (check my phone less often) gradually increased, however, during the change interview she reflected that this was perhaps not the case, "well, I think I've exaggerated a bit with that five… 'cause I'm not that good at it! But I'm trying!".

There was fluctuation in the achievement rating for her second goal (to be able to have a study session without checking my phone every 15 mins).
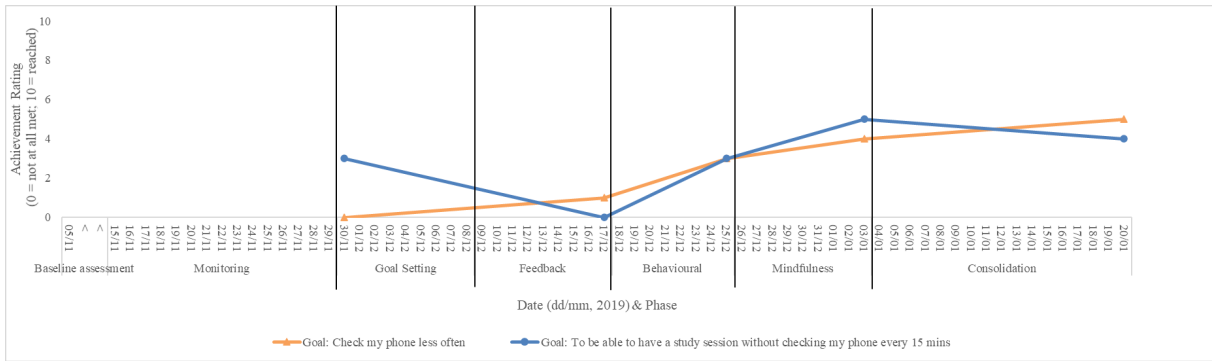
Figure 26: Purple goal achievement ratings

4.3.8   Change interview

The key changes described by Purple during the interview are outlined in Table 10. Purple said that the most helpful aspect of the study had been the feedback, "definitely the statistics I got…I think it was really useful", and this increasing her awareness; "well maybe the fact that I'm more aware of it…I think's the best part…like the best bit I got out of it. I'm actually aware that I use my phone too much". Purple identified a negative change alongside this, which was feeling more guilty, although she did say "I tend to guilt trip myself about everything".

Table 10: Changes reported by Purple during interview

Description of change	Expectancy of change	How likely would it have been without the study	Importance of change
Reducing use of specific apps (Gardenscapes and Facebook)	Very much surprised by it	Very unlikely without the study (clearly would not have happened)	Moderately important
Becoming more aware of phone use	Very much expected it	Very unlikely without the study (clearly would not have happened)	Very important
Feeling guilty about phone use	Very much expected it	Very unlikely without the study (clearly would not have happened)	Missing data

When Purple was asked what she would have liked to change but hasn't she said: "oh that checking my phone every 15 minutes…that definitely hasn't changed", she said that she felt she was a little better in this area but definitely not whilst studying (which was one of her goals).

Purple reflected that as the study delivered messages via her phone, this did not help with using her phone less. She said that she would have preferred face-to-face conversations; "'cause I'm putting the phone away and I'm talking to a person". She also suggested that a checkbox after each message asking whether you had tried it and what you thought of it might have been motivating, "to push the person to actually do it".

Purple said that she would recommend the intervention to others and that overall, she had found it: "really interesting and entertaining to get all this information". She said that she would continue to use some of the suggestions, such as being present whilst eating rather than using her phone at the same time, but would adapt some to increase their usefulness to her (e.g. turning her data off, so she could still see her phone but would not get notifications, rather than putting it out of sight).

Towards the end of the interview she reflected on her sense of problematic phone use: "I think that's the most important, how problematic it is…cause as we've said like they are everything you need in one little thing…so it is understandable that people use it a lot…I think it's more like high usage…that should be kind of focused".

4.3.9   Conclusion

Purple found engaging with the study challenging. Some of the information provided by Purple during the change interview was contradictory (e.g. stating that she did not find the mindfulness interventions useful but stating she would continue using one of them), and contradicted her survey responses (e.g. stating she had not made progress towards her goal, despite rating it as such). Despite these contradictions, the standardised measures clearly indicate an improvement in problematic smartphone use.

Overall, there is evidence of a reduction in problematic phone use, although Purple still feels she has progress to make. The key benefit Purple described was increased awareness of her phone use, which she felt was very important, although this did also lead to increased feelings of guilt.

4.4 Participant four: Yellow

Yellow is an 18-year-old white British female, in her first year of studying civil engineering. In the recruitment survey she reported that the amount of time she spends on her phone had increased in the last twelve months, that she thought about cutting down the time she spends on her phone, and that she was sure she spent more time on her phone than she should.

During the change interview Yellow was asked to reflect on her reasons for participating in the study. She said that she had been using her phone more since starting university, and that she was curious about both her phone use and her sleep. She said that she mainly uses her phone for socialising, but that she would like to use it less, as there are times when it replaces face-to-face contact unnecessarily (e.g. texting a neighbour instead of visiting their flat).

Yellow has previously been able to reduce her phone use by placing her phone in another room, but only when she had something she needed to focus on (during A-level revision). She also said that turning her notifications to vibrate is helpful, as well as placing it face down on the table. She explained that she might receive unimportant notifications and then: "pick up my phone and then get distracted and do other things".

Yellow scored within the mild range for dependence on the online world (as measured by the IAT) and scored above the clinical cut-off for psychological distress (as measured by the CORE-OM). The recruitment survey asked whether participants had problems with sleep in general, Yellow selected *no*. However, she did say that she had had problems with waking too early, and feeling tired/unrested in the morning.

Yellow was randomly allocated to complete the behavioural phase followed by the mindfulness phase.

Table 11: Yellow pre-post measure scores

Measure	Pre	Post	Pre - Post	Direction of Change
MPPUS	171	141	30	Reliable Improvement
IAT	47[a]	39[a]	8	Improvement
MAAS	4.13	3.79	0.34	Deterioration
WEMWBS	43	52	-9	Reliable Improvement
CORE-OM	12.4[b]	8.2	4.2	Reliable Improvement
BPNSS: Autonomy	26	26	0	No Change
BPNSS: Competence	25	29	-4	Improvement
BPNSS: Relatedness	39	39	0	No Change

n.b. reliable indicates that the reliable change criteria was met
[a] mild
[b] above clinical cut-off

4.4.1 Engagement

Yellow reported that she had read six of the seven feedback messages and rated their usefulness 6/10. She reported trying three of the seven behavioural suggestions and rated their usefulness 6/10. Of the mindfulness suggestions, she reported trying two of the seven and rated their usefulness 6/10. Yellow reflected in the change interview that she had at times forgotten to try the suggestions, but said it was helpful that they remained accessible on the app, "so that was helpful, like you could go back when you want to". Yellow completed 78% of the daily measures.

4.4.2 Smartphone usage

Yellow's screen time is presented in Figure 27. The figure shows small increases in screen time across the first five phases, and a decrease in the consolidation phase, where screen time is at its lowest. Yellow disagreed less with the statement "I felt in control of my smartphone use" as the study progressed (see Figure 27). During the change interview Yellow said that her smartphone use had changed: "I feel like I've been using it differently umm, as opposed to less"
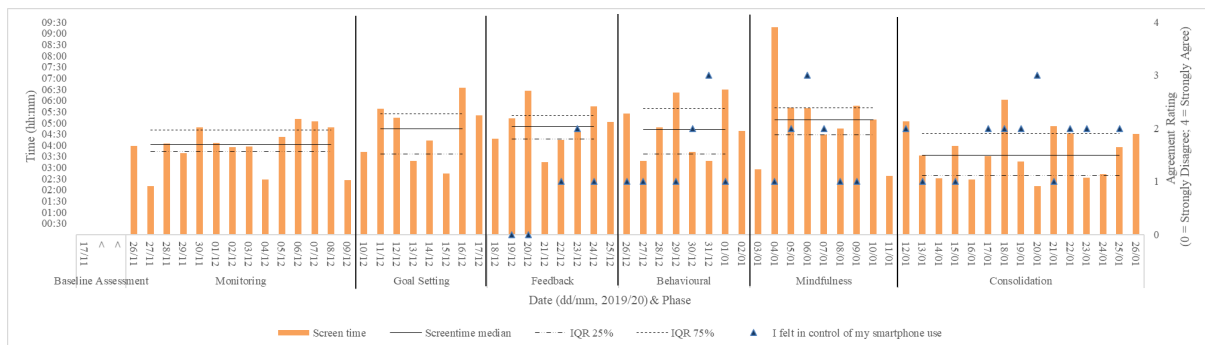
Figure 27: Yellow daily screen time and daily measure (I felt in control of my smartphone use) rating

Yellow's score on the MPPUS showed a reliable reduction (see Table 11) suggesting an improvement in problematic phone use. There was also an improvement on the IAT, although this did not meet the reliability criteria (see Table 11).

In summary, there is a small reduction Yellow's screen time in the final stage of the study, and the self-report measures provide evidence of a reduction in problematic use.

4.4.3 Mindfulness

Figure 28 and Table 11 show a slight deterioration in Yellow's MAAS score between the start and end of the study, although this was not a reliable change. Yellow's agreement with the daily mindfulness measure, "I found it difficult to stay focused on what was happening in the present", shows variation across all phases.

Figure 28: Yellow MAAS and daily measure (I found it difficult to stay focused on what was happening in the present) rating

4.4.4　Wellbeing and psychological distress

A gradual increase is seen in the SWEMWBS over the course of the study (see Figure 29). There was a reliable improvement in the WEMWBS and the CORE-OM between the start and end of the study, with the CORE-OM moving below the clinical cut-off score (see Table 11).

The daily measures seen in Figure 30 and Figure 31 show variation across the study phases, there is a slight increase in unhappiness and decrease in closeness to others during the mindfulness phase.

Figure 29: Yellow SWEMWS Total Scores

Figure 30: Yellow daily measure (I felt unhappy) agreement ratings

Figure 31: Yellow daily measure (I felt close to other people) agreement ratings

4.4.5 Self-determination

The BPNSS competence subscale showed improvement over the course of the study (see Table 11). Figure 32 illustrates that Yellow's response to the daily measure (which was taken from the competence subscale of the BPNSS) showed variation in all phases.
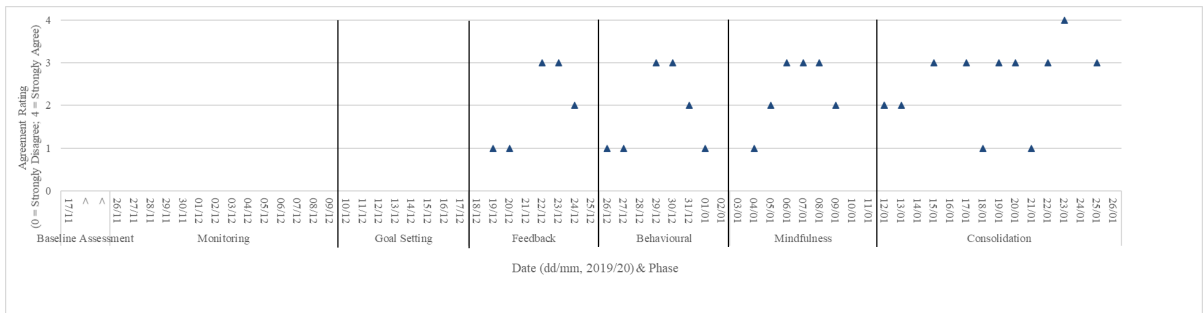
Figure 32: Yellow Daily measure (I felt a sense of accomplishment from what I did) agreement ratings

4.4.6 Sleep

There does not appear to be a clear pattern of change in sleep duration between the phases (see Figure 33). Yellow most frequently responded *disagree* to "I had difficulty getting to sleep or staying asleep".

When asked in the final survey, Yellow reported continued difficulties with waking too early but no longer reported difficulties with feeling tired and unrested.
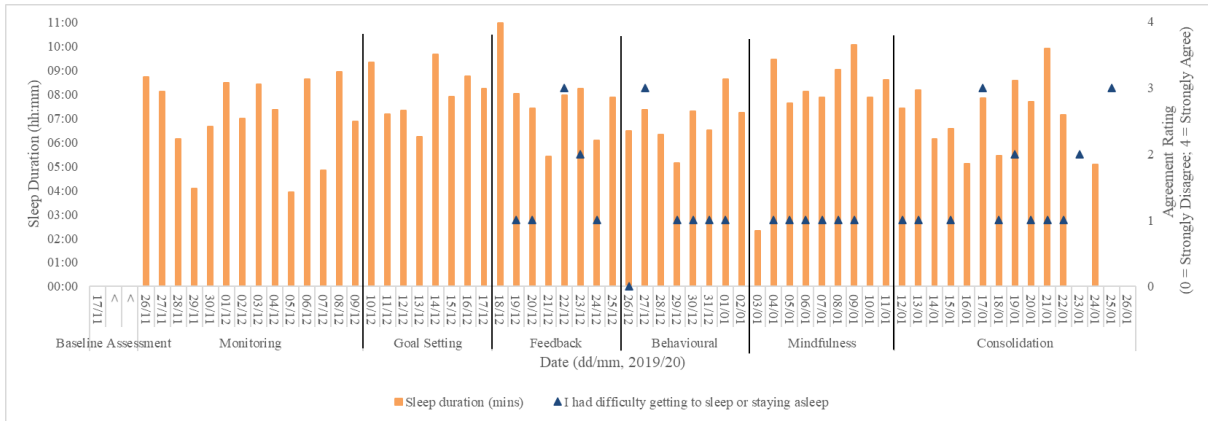
Figure 33: Yellow sleep duration & daily measure agreement rating (I had difficulty getting to or staying asleep)

4.4.7 Goals

The goal achievement ratings reported by Yellow show improvements (see Figure 34) over the course of the study. Although there was a slight decrease in the achievement rating of her first goal (be less distracted by my smartphone) during the feedback phase, this increased in all subsequent phases.
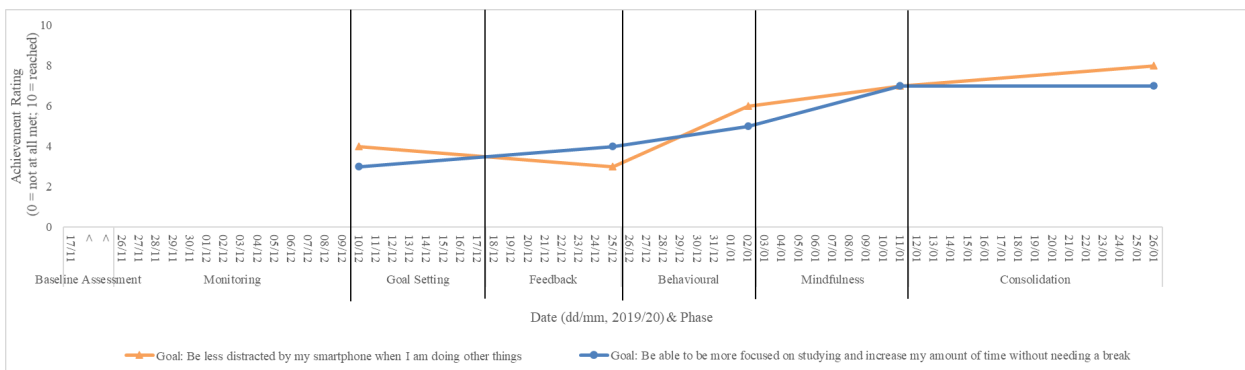
Figure 34: Yellow goal achievement ratings

4.4.8 Change interview

The key changes described by Yellow during the interview are outlined in Table 12. Yellow identified several helpful ideas she had taken from the study: breaking tasks down, turning off all notifications, and practising mindfulness.

When Yellow was asked what she thought had contributed to the changes outlined in Table 12, she said increased awareness (of how she was spending her time), time off over Christmas (enabling her to feel calmer), and ideas for being on her phone less. When she was asked if there were any particular ideas that she had found helpful for this, she specified turning off notifications and delaying checking, "if you want to check your phone, well check it in 15 minutes…I found pretty useful 'cause I'd only check it now and then, like I'll

finish this and then I'll check it". She also specified one of the mindfulness activities, stating that she found it helpful to focus on something external if she felt overwhelmed.

Table 12: Changes reported by Yellow during interview

Description of change	Expectancy of change	How likely would it have been without the study	Importance of change
Being more organised and staying on top of things	Somewhat surprised by it	Neither likely nor unlikely (no way of telling)	Very important
Feeling more confident (to interact with others face-to-face)	Somewhat expected it	Somewhat likely without the study (probably would have happened)	Moderately important
Drinking less (alcohol)	Somewhat surprised by it	Somewhat unlikely without the study (probably would not have happened)	Slightly important
Improved sleep pattern	Neither expected nor surprised by the change	Somewhat unlikely without the study (probably would not have happened)	Very important

Yellow was asked if there was anything that she thought was missing from the intervention, she said that she would have liked some additional feedback: "maybe like comparisons. So, like at the beginning you had like times that you'd spent on things…maybe like half-way through like a new update".

She said that she would continue to use the strategies that she had identified as helpful, but did say that she would turn some of her notifications back on, "like emails and stuff like that…like ones where I have to do something".

Yellow reflected overall on how she is using her phone differently: " I am using it in a more useful way…I'm getting better at using it for just the useful thing without getting distracted by other things, which I think is linked to the notifications". Yellow reflected on her feelings towards her phone use "I feel better about like about being on it, and I'm getting more work done".

Yellow said that she would recommend the intervention to others and said: "I think it's good for anyone who feels like they need to sort of spend less time on their phone".

4.4.9 Conclusion

Overall, there is evidence that Yellow's problematic smartphone use has reduced, and that she has changed the way in which she is using her phone. There is also evidence that Yellow's wellbeing has improved, and level of psychological distress reduced. The key changes outlined by Yellow in the change interview were not directly linked to smartphone use, but she felt that they were influenced by the interventions she engaged with.

4.5   Participant five: Orange

Orange is a 21-year-old white European female in her third year of study in the School of Languages, Cultures and Societies. In the recruitment survey, she reported that the amount of time she spends on her phone had increased over the previous twelve months. She said that she possibly spent more time on her phone than she should, and that she thought about cutting down.

During the change interview, Orange was invited to reflect on her reasons for participating in the study. She said that she wanted to spend less time on her phone and improve her sleep quality (as she tended to use her phone before going to sleep and as soon as she woke up).

She explained that her smartphone use had gradually increased over a number of years and said "with the smartphones playing such an important part in our lives now I think that's why it has gone up". Orange reflected on what happens when using her phone around others; "like you're surrounded by other people but you're like in your own zone…you just seclude yourself from everybody". She reflected that her smartphone use has had a negative impact on her eyesight and caused headaches, and that she is wasting her time using her phone (e.g. scrolling through Facebook, when she would like to do something more productive).

The recruitment survey placed Orange within the mild range for dependence on the online world (as measured by the IAT). She scored below the clinical cut-off for psychological distress (as measured by the CORE-OM). The recruitment survey asked whether participants had problems with sleep in general, Orange selected *yes* to this question, as well as to the more specific questions about getting to sleep, waking during the night or too early, and feeling tired or unrested.

Orange was randomly allocated to complete the mindfulness phase followed by the behavioural phase.

Table 13: Orange pre-post measure scores

Measure	Pre	Post	Pre - Post	Direction of Change
MPPUS	130	140	-10	Deterioration
IAT	33[a]	30	3	Improvement
MAAS	3.93	3.87	0.07	Deterioration
WEMWBS	49	56	-7	Improvement
CORE-OM	7.1	8.8	-1.7	Deterioration
BPNSS: Autonomy	34	29	5	Deterioration
BPNSS: Competence	28	26	2	Deterioration
BPNSS: Relatedness	36	37	-1	Improvement

[a] *mild*

4.5.1 Engagement

Orange reported that she had read all seven of the feedback messages and rated their usefulness 5/10. She reported trying three of the seven mindfulness suggestions and rated their usefulness 6/10. Of the behavioural suggestions, she also reported trying three of the seven and rated their usefulness 6/10. Orange completed 47% of the daily measures

4.5.2 Smartphone usage

A clear increase in screen time duration can be seen in the feedback phase for Orange (Figure 35). The goal setting and consolidation phases show the lowest screen time medians. During the change interview Orange said that she had returned home for the holidays between 14/12/19 and 11/01/20 and that she would expect her phone use to be higher during this period, although the data shows that this was not true for the whole period.
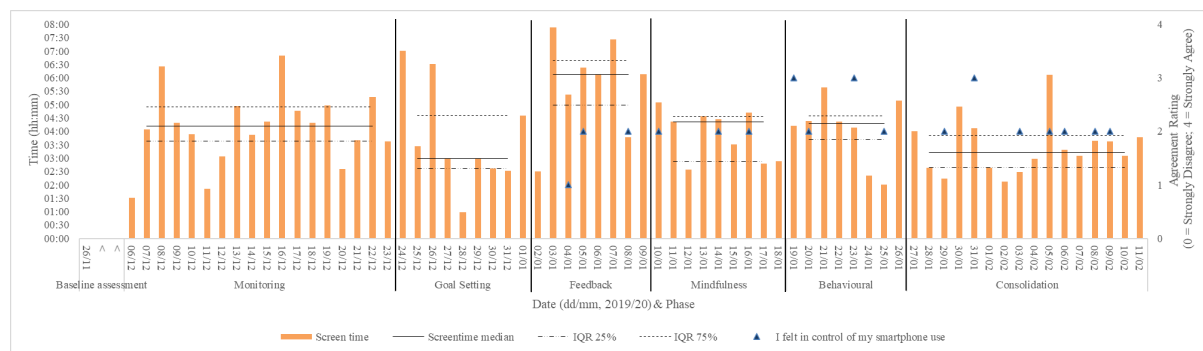
Figure 35: Orange daily screen time and daily measure (I felt in control of my smartphone use) rating

The MPPUS showed a small deterioration and the IAT showed a small improvement, neither of these reached the criteria for reliability (see Table 13).

Given the fluctuations in Orange's screen time over the course of the study, there is no indication of a clear change in response to the intervention. In addition, the measures suggest that there has been no significant change in problematic phone use. Contrary to this, Orange did describe some changes during the change interview (4.5.8).

4.5.3   Mindfulness

Overall, there is a slight (not reliable) deterioration in Orange's MAAS score (see Table 13). Both her MAAS score and her daily mindfulness measure agreement rating fluctuate over the course of the study (see Figure 36).
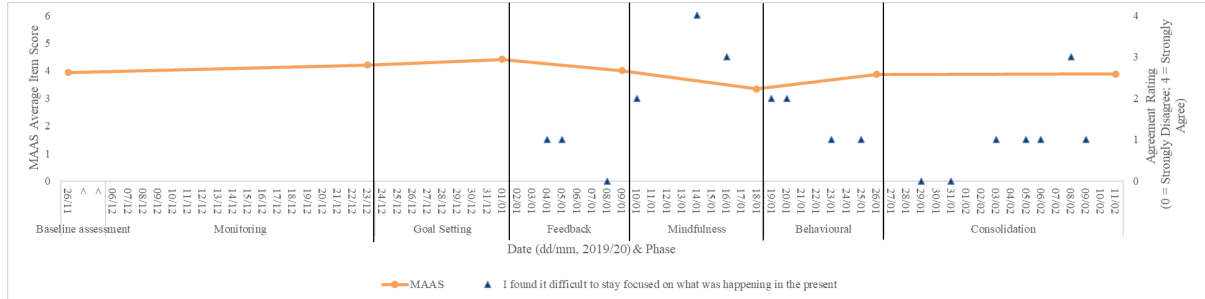
Figure 36: Orange MAAS and daily measure (I found it difficult to stay focused on what was happening in the present) rating

4.5.4   Wellbeing and psychological distress

Fluctuations are seen in Orange's SWEMWBS over the course of the study (Figure 37). From start to end, there was a slight improvement in her WEMWBS score and a slight deterioration in her CORE-OM score, although neither changes were reliable (see Table 13).

The daily measure (Figure 38) indicates that Orange felt most unhappy during the mindfulness phase, this is consistent with the SWEMWBS score (Figure 37). Orange felt closer to others during the feedback phase compared to later phases of the study (see Figure 39).
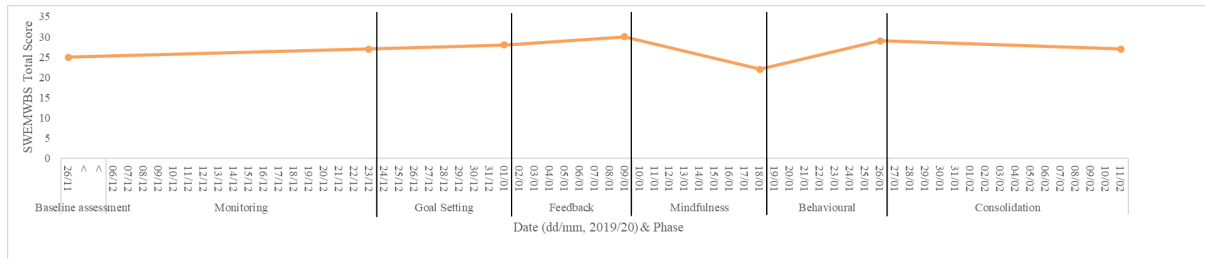
Figure 37: Orange SWEMWS Total Scores

Figure 38: Orange daily measure (I felt unhappy) agreement ratings

Figure 39: Orange daily measure (I felt close to other people) agreement ratings

4.5.5 Self-determination

The BPNSS showed small deteriorations in autonomy and competence, and a slight improvement in relatedness (see Table 13). There was variation in the daily measure, with the lowest scores appearing in the mindfulness phase (see Figure 40).

Figure 40: Orange Daily measure (I felt a sense of accomplishment from what I did) agreement ratings

4.5.6 Sleep

Sleep duration became more consistent during the consolidation period (see Figure 41). The daily measure shows greater disagreement with the statement: "I had difficulty getting to sleep or staying asleep" during the final two phases (behavioural and consolidation).

When asked in the final survey, Orange no longer reported overall difficulties with her sleep, nor with waking in the night or too early. She reported continued difficulties with getting to sleep and feeling tired or unrested.
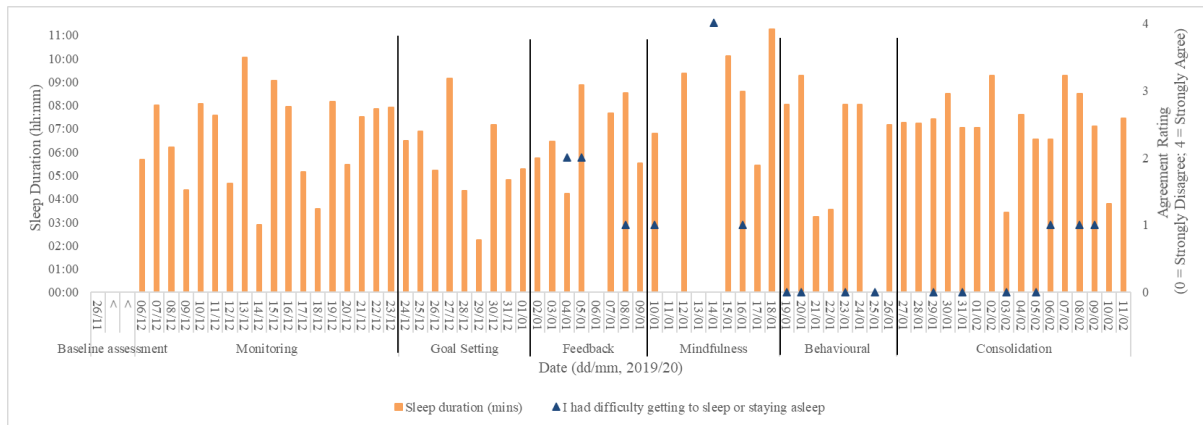
Figure 41: Orange sleep duration & daily measure agreement rating (I had difficulty getting to or staying asleep)

4.5.7 Goals

Overall, Orange reported improvements in both of her goals (see Figure 42). There was a reduction in achievement of Orange's second goal (spend more time studying and improve my grades) following the feedback phase, but this subsequently increased. During the change interview Orange reflected on the difficulty of seeing herself in an objective way, but said "with regards to, you know my exams, I did really good", which she felt evidenced her achievement of her second goal.
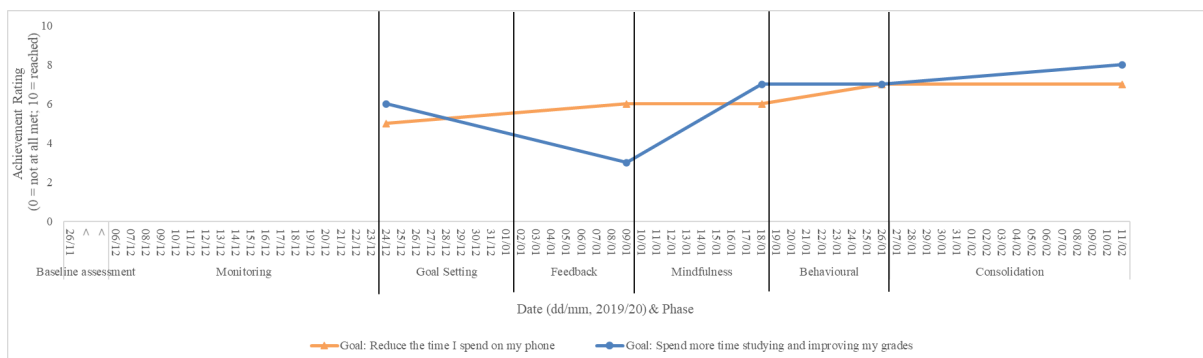
Figure 42: Orange goal achievement ratings

4.5.8 Change interview

The changes described by Orange during the interview are outlined in Table 14. When Orange was asked what she thought had contributed to the changes outlined, she said that the graphs (sent to her during the feedback phase) were helpful to begin with, and then reflected on some specific ideas from the study: "definitely the ones to leave the phone in another

room…or to try eating or to try do other activity without looking at your phone", she also mentioned the mindful breathing exercise.

Table 14: Changes reported by Orange during interview

Description of change	Expectancy of change	How likely would it have been without the study	Importance of change
Spending less time on phone	Very much expected it	Somewhat unlikely without the study (probably would not have happened)	Moderately important
Increased awareness of phone use	Somewhat surprised by it	Neither likely nor unlikely (no way of telling)	Moderately important
Being more present	Somewhat surprised by it	Somewhat likely without the study (probably would have happened)	Very important

In becoming aware of her smartphone use Orange realised she was dependent: "I became more aware of how much time I actually spend…and like how dependent I am on my smartphone". She said that she would like to reduce her smartphone use further: "Like before going to bed…like first thing in the morning not touching my phone but I'm still working on that unfortunately", although she did say that she was switching her data off before going to sleep.

Orange said that she had tried not to use her phone when engaging in activities (e.g. watching a film) or spending time with others prior to the study, but that she was making more of an effort to do this now. She explained that she would leave her phone in another room or in her bag, or switch off her data.

Orange said that she would have preferred to receive a mix of the different intervention messages, rather than in separate phases; she found the feedback messages helpful to begin with but would have preferred to receive suggestions alongside these as the intervention progressed. Orange also reflected that she would have preferred more face-to-face contact, "to come in person to just like meet up, I think that would be better because I was using my phone (to access the intervention messages)".

Orange said that she would recommend the intervention to others and that she would "definitely" continue using the ideas learnt, she planned to continue engaging with mindfulness and experimenting with ways of reducing her smartphone use.

4.5.9 Conclusion

Overall, the data does not provide evidence of significant changes for Orange over the course of the study. She does clearly describe some changes and learning points during the change interview, as well as rating progress towards achieving her goals.

4.6 Participant six: Red

Red is a 19-year-old white British female; she is in her second year of study in the School of Computing. In the recruitment survey she reported that the amount of time she spends on her phone had increased in the previous twelve months, that she thought about cutting down the time she spends on her phone, and that she was sure she spent more time on her phone than she should.

During the change interview Red was asked to reflect on her reasons for participating in the study. She said that she was aware she used her phone a lot, and wanted to reduce it, particularly during the exam period. She reflected on when she had been working abroad over the summer; "I only had my phone for like an hour a day…I found that was quite good…I didn't really think about it…and I was thinking if I can do it then why can't I do it when I come home?", but acknowledged that she needs it more at home (e.g. to make arrangements with friends, which she was not doing whilst away). Red felt that living away from her family for university resulted in an increase in phone use; "I obviously want to be on my phone as long as possible in case they want to get hold of me or something, a family emergency or something like that".

Red explained that she can sometimes use her phone as a barrier to hide behind, as well as when she is bored. She also reflected on the impact of other people's behaviour; for example if she is trying to engage her friends in conversation but they are on their phones, she will then do the same.

Red scored within the mild range for dependence on the online world (as measured by the IAT) and scored above the clinical cut-off for psychological distress (as measured by the CORE-OM). The recruitment survey asked whether participants had problems with sleep in general, Red selected *yes*; she indicated that she had problems with getting to sleep, waking during the night or too early, and feeling tired/unrested in the morning.

Red was randomly allocated to complete the behavioural phase followed by the mindfulness phase.

Table 15: Red pre-post measure scores

Measure	Pre	Post	Pre - Post	Direction of Change
MPPUS	149	143	6	Improvement
IAT	57[a]	52[a]	5	Improvement
MAAS	3.93	4.33	-0.4	Improvement
WEMWBS	48	56	-8	Reliable Improvement
CORE-OM	10.00[b]	11.18[b]	-1.18	Deterioration
BPNSS: Autonomy	27	30	-3	Improvement
BPNSS: Competence	33	33	0	No Change
BPNSS: Relatedness	39	37	2	Deterioration

n.b. reliable indicates that the reliable change criteria was met
[a] moderate
[b] above clinical cut-off

4.6.1 Engagement

Red reported that she had read all seven of the feedback messages and rated their usefulness 6/10. She reported trying all seven of the behavioural suggestions and rated their usefulness 7/10. Of the mindfulness suggestions, she reported trying four of the seven and rated their usefulness 4/10. Red completed 76% of the daily measures.

4.6.2 Smartphone usage

Red's screen time median increased over the first three phases and decreased in the behavioural phase; a subsequent increase is seen in the consolidation phase (see Figure 43). In the change interview Red stated that she had a period of exams between 6th and 14th January; this may have contributed to reduced screen time during the behavioural phase, but does not explain the maintenance of this reduction across the mindfulness phase. There is variation in Red's rating of feeling in control of her smartphone use across all phases (see Figure 43).

During the change interview, Red said that she was expecting to see a reduction in her screen time, whilst looking at the data she said; "I'm quite surprised by that cause I genuinely thought it would've gone down 'cause I felt like I was using it less".
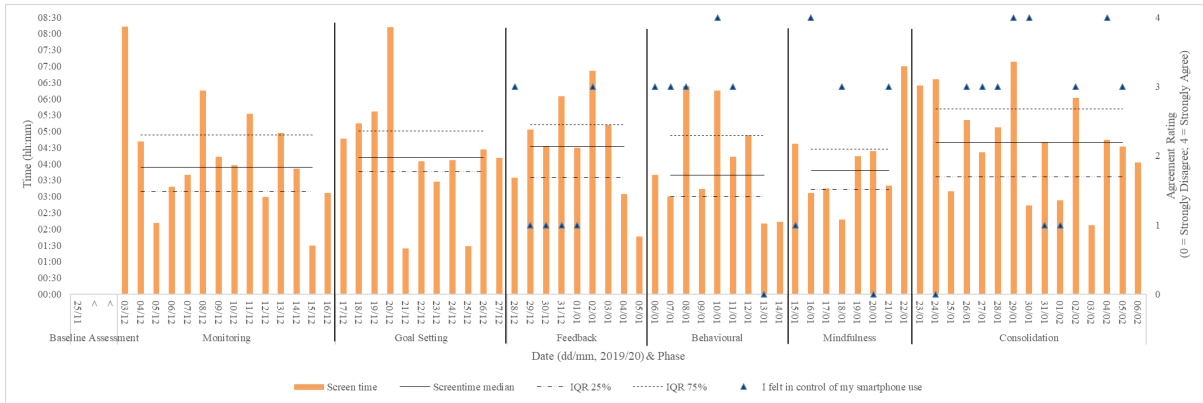
Figure 43: Red daily screen time and daily measure (I felt in control of my smartphone use) rating

Both the MPPUS and the IAT improved over the course of the study, although these changes were not reliable (Table 15).

Overall, the quantitative data does not indicate a change in problematic use over the course of the study. Contradictory to this, Red did report changes in the change interview (4.6.8).

4.6.3 Mindfulness

Red's MAAS score improved between the start and end of the study, although this overall change was not reliable (see Table 15). There was a reliable improvement in the scores recorded before and after the mindfulness phase (see Figure 44). The daily measure scores vary across the phases, although there are some *strongly disagree* responses to finding it difficult to focus on the present during the mindfulness and consolidation phases, which is not seen in other phases.
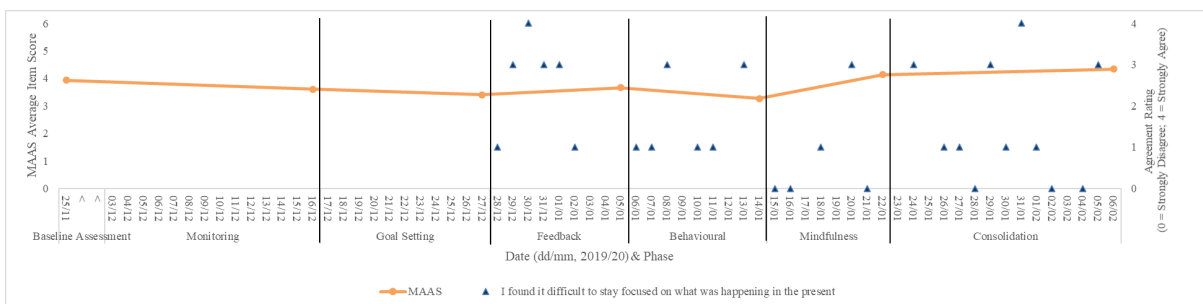
Figure 44: Red MAAS and daily measure (I found it difficult to stay focused on what was happening in the present) rating

4.6.4 Wellbeing and psychological distress

Variation is seen in Red's SWEMWBS scores across the study (Figure 45). There was a reliable improvement in the overall WEMWBS score between the start and end of the study

(see Table 15). Red's CORE-OM score showed a small deterioration, which was not reliable (see Table 15).

There was variation across the daily measures (Figure 46 & Figure 47) throughout the study, with some lower agreement ratings of feeling close to others and increased agreement with feeling unhappy in the consolidation phase. During the change interview Red said that there were some days she really did not feel close to people and said "I think it's 'cause they're using their phone".
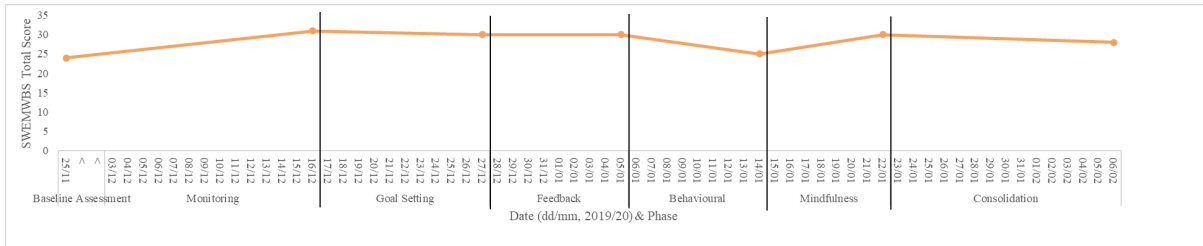
Figure 45: Red SWEMWS Total Scores
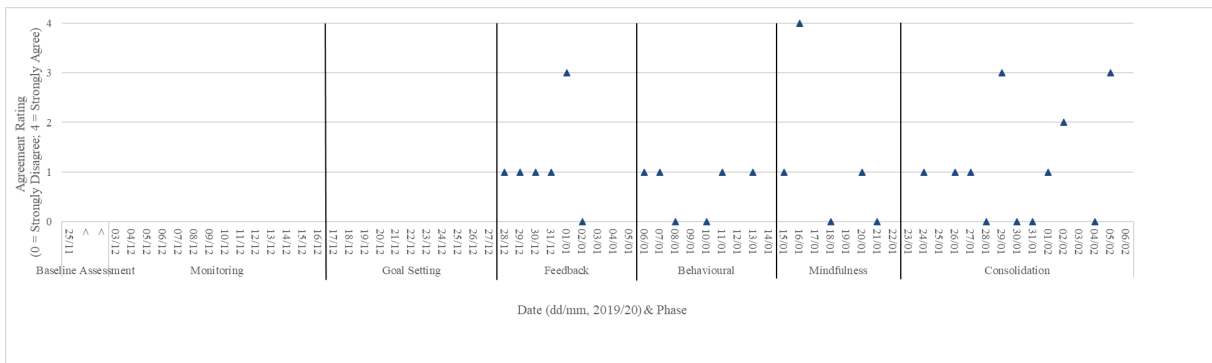
Figure 46: Red daily measure (I felt unhappy) agreement ratings
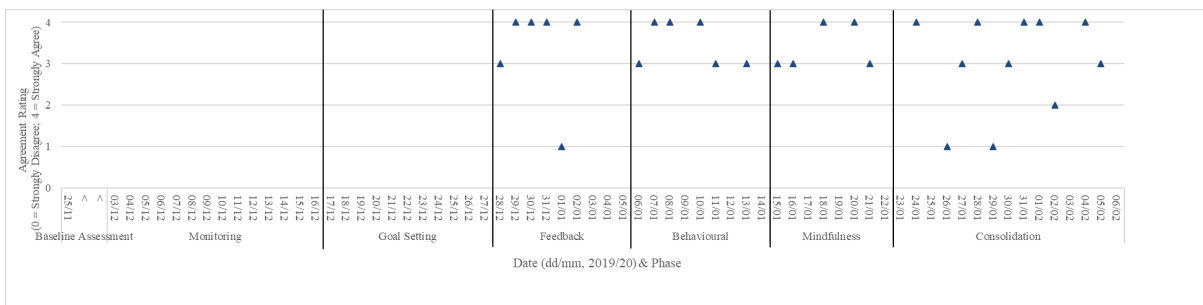
Figure 47: Red daily measure (I felt close to other people) agreement ratings

4.6.5 Self-determination

The BPNSS showed a small improvement in autonomy and a small deterioration in relatedness (see Table 15). The daily measure varied across all phases (see Figure 48).
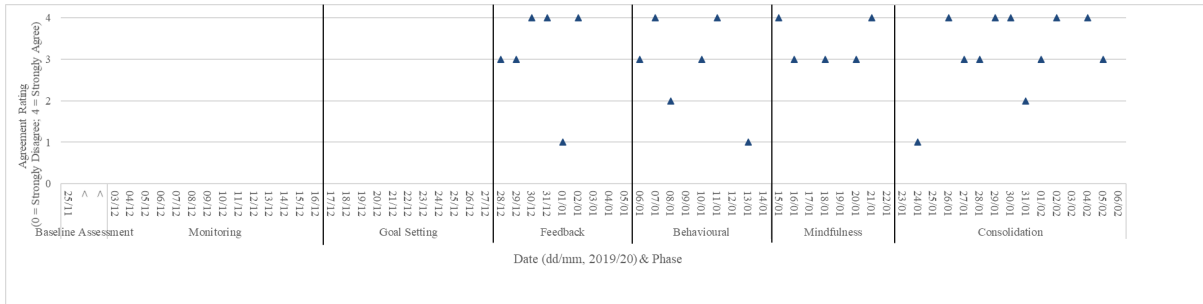
Figure 48: Red Daily measure (I felt a sense of accomplishment from what I did) agreement ratings

4.6.6   Sleep

Sleep duration is shown alongside agreement ratings of the daily measure question (Figure 49). Sleep duration appears to fluctuate more in the consolidation phase than other phases, and there is an increase in overall sleep duration compared to other phases. There is also increased agreement with "I had difficulty getting to or staying asleep" during this phase.

When asked in the final survey if she had problems with sleep in general, Red selected *no*. She did however select *yes* to experiencing difficulties getting to sleep, waking during the night or too early, and feeling tired/unrested in the morning.
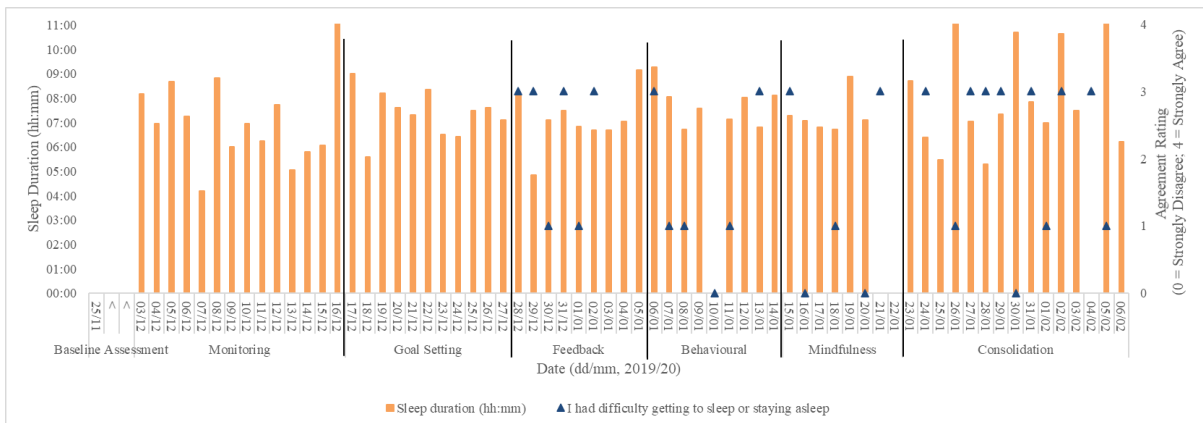
Figure 49: Red sleep duration & daily measure agreement rating (I had difficulty getting to or staying asleep)

4.6.7   Goals

Goal achievement ratings can be seen in Figure 50; there were overall increases for both goals over the course of the study. After the behavioural phase there was an increase in Red's achievement of her first goal to spend less time on social media, but a dip in her second goal to spend more time with her family, and the opposite can be seen after the mindfulness phase. In the change interview Red reflected on the relationship between the two goals; explaining that as she lives away from her family she maintains contact via her phone, she said: "I spend less time on my phone, I focus more on people here", feeling that

she is connecting more with people at university as a result of using her phone less, but also speaking less to her family.
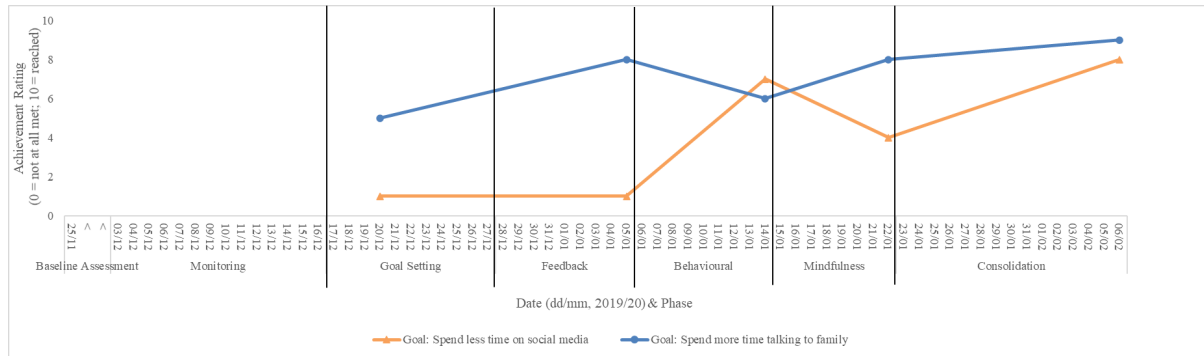
Figure 50: Red goal achievement ratings

4.6.8 Change interview

The changes described by Red during the interview are outlined in Table 16. Red spoke about her urge to respond to notifications prior to the study and described this as automatic; "before I'd be like automatically reply; like the instant reaction kind of thing", suggesting that this has changed. She also said that her phone always occupied some of her attentive capacity; "even when I was doing something, one third focused on my phone". She reflected on the impact of being focused on her phone; "I'd just been so focused I hadn't…like my hearing was almost like blocked off", referring to when her family were trying to engage with her at home, she said that this could create conflict.

Table 16: Changes reported by Red during interview

Description of change	Expectancy of change	How likely would it have been without the study	Importance of change
Increased awareness of phone use	Very much surprised by it	Somewhat likely without the study (probably would have happened)	Extremely important
Being more energetic and motivated	Very much surprised by it	Neither likely nor unlikely (no way of telling)	Very important
Being more focused and less distracted by phone	Very much expected it	Somewhat unlikely without the study	Extremely important

		(probably would not have happened)	
Being more present, and more engaged with the world around me	Somewhat surprised by it	Very likely without the study (clearly would have happened anyway)	Slightly important

Red described the feedback messages as having a shock factor: "I think what motivated me, I'd say that was a bit of a shock factor of me wanting to do something", and said that the later feedback message illustrating that her average screen time had reduced was encouraging, leading her to think: "well actually I can do it".

Red explained that the family conflicts she had experienced might have motivated her to try and make changes, but that it would have been unlikely to have been impactful without the study: "I don't know if I'd not done the study whether I'd have bothered, if I'm honest…I'd have probably like tried to switch it off like an hour before I went to bed or putting it out of sight kind of thing. But I don't think I'd have really thought about, you know specific time or minutes. I don't think I'd have thought about turning off notifications".

Red found it difficult to turn her phone off, and said that when she did she replaced it with another device, "I did struggle because then I was like automatically, I would just go on my laptop".

When Red was asked if there was anything she thought would have improved the intervention; she revisited her reflection that her friends tended to use their phone when she was engaging with them, and said that she thought it would be interesting for the intervention to be offered to a small group of friends, saying: "I feel like that might have changed their perspective as well; and then we also might have ended up spending less as a whole because then someone else is motivated to do something".

Red said that she would recommend the intervention to others and that she planned to continue using the suggestions of turning off notifications and keeping her phone out of sight whilst doing other activities (e.g. eating). She felt that the intervention would be helpful if developed into something longer-term, "…would be a good idea having it a lot more long term. You could then download to help yourself.".

4.6.9 Conclusion

Overall, the quantitative data indicates an improvement in wellbeing, but not in the other areas. The qualitative data gathered in the change interview, alongside Red's ratings of her self-identified goals, do suggest meaningful changes for Red in relation to her smartphone use and level of mindfulness.

4.7 Participant seven: Grey

Grey is a 21-year-old European male, who had recently finished his second year of studying in the school of mechanical engineering. In the recruitment survey he reported that the amount of time he spends on his phone had reduced in the last twelve months, that he thought about cutting down the time he spends on his phone, and that he possibly spent more time on his phone than she should.

During the change interview Grey was asked to reflect on his reasons for participating in the study. He said that he wanted to improve his relationship with his phone, and to reduce the time he spent on his phone unintentionally. He explained that he hoped being able to control his phone use would improve his productivity, academic performance, mental health, and social interactions.

He has tried to reduce his problematic phone use in the past, through reducing his notifications and turning it to flight mode whilst studying. He has also tried scheduling his time, for the following reason: "it doesn't give me much opportunity to…get lost in the…online world". He said that he had found these things helpful to some extent.

Grey explained that his mobile phone was one of the things he used to manage stress, discomfort and loneliness. He reflected on his phone being both useful and problematic; "I find it really useful in many ways… but it's when um, I'm not intending to use it as much that it becomes a problem".

Grey scored within the moderate range for dependence on the online world (as measured by the IAT) and scored above the clinical cut-off for psychological distress (as measured by the CORE-OM). The recruitment survey asked whether participants had problems with sleep in general, Grey selected *no*, but did say that he had difficulty with feeling tired/unrested in the morning.

Grey was randomly allocated to complete the behavioural phase followed by the mindfulness phase.

Table 17: Grey pre-post measure scores

Measure	Pre	Post	Pre - Post	Direction of Change
MPPUS	160	121	39	Reliable Improvement
IAT	50[b]	42[a]	8	Improvement
MAAS	4.47	5.53	-1.07	Reliable Improvement
WEMWBS	48	58	-10	Reliable Improvement
CORE-OM	10.88[c]	4.71	6.18	Reliable Improvement
BPNSS: Autonomy	29	30	-1	Improvement
BPNSS: Competence	28	﹨		
BPNSS: Relatedness	35	36	-1	Improvement

n.b. reliable indicates that the reliable change criteria was met
[a] mild
[b] moderate
[c] above clinical cut-off
﹨ missing data

4.7.1 Engagement

Grey reported that he had read all seven of the feedback messages and rated their usefulness 6/10. He reported trying three of the seven behavioural suggestions and rated their usefulness 7/10. Of the mindfulness suggestions, he reported trying five of the seven and rated their usefulness 7/10. Grey completed 92% of the daily measures.

4.7.2 Smartphone usage

An increase can be seen in Grey's screen time median during the feedback phase, followed by a decrease during the behavioural and mindfulness phases (see Figure 51). The screen time median during the consolidation phase is similar to the monitoring phase, although there is less variation, as indicated by the interquartile ranges.

Figure 51: Grey daily screen time and daily measure (I felt in control of my smartphone use) rating

The MPPUS showed a reliable improvement (see Table 17) over the course of the study. The daily measure agreement ratings displayed in Figure 51 show that Grey felt more in control of his smartphone use during the final three phases of the study than he did during the feedback phase.

The IAT also showed a small improvement, which did not meet the reliability criteria (see Table 17).

On balance, although there is no clear change in the amount of time Grey is spending on his phone, the measures suggest a reduction in problematic use. This improvement in problematic use is corroborated by qualitative data gathered during the change interview (4.7.8).

4.7.3 Mindfulness

Grey's level of mindfulness (as measured by the MAAS) showed a reliable increase over the course of the study (see Table 17). The largest increase in the MAAS occurred during the behavioural phase (see Figure 52). The daily measure does not show much variation, but *strongly disagree* ratings are seen only in the final two phases of the study - mindfulness and consolidation (see Figure 52).

Figure 52: Grey MAAS and daily measure (I found it difficult to stay focused on what was happening in the present) rating

4.7.4 Wellbeing and psychological distress

Both the WEMWBS and the CORE-OM showed reliable improvements for Grey between the start and the end of the study; the change in the CORE-OM was clinically significant (see Table 17). The SWEMWBS scores show the biggest improvement in wellbeing occurred during the behavioural phase (see Figure 53).

During the feedback phase Grey expresses agreement with feeling unhappy and disagreement with feeling close to others, which is not seen in the other phases (see Figure 54 & Figure 55).

Figure 53: Grey SWEMWS Total Scores

Figure 54: Grey daily measure (I felt unhappy) agreement ratings

Figure 55: Grey daily measure (I felt close to other people) agreement ratings

4.7.5 Self-determination

Owing to missing data not all subscales of the BPNSS could be interpreted. The subscales without missing data (autonomy and relatedness) both showed an improvement of 1 point (see Table 17). The feedback phase is the only phase in which Grey disagrees with the statement "I felt a sense of accomplishment from what I did" (see Figure 56).

Figure 56: Grey daily measure (I felt a sense of accomplishment from what I did) agreement ratings

4.7.6 Sleep

Grey's sleep duration appears to be consistent across phases, the daily measure shows more consistent *strongly disagree* responses to having difficulty getting to or staying asleep from the mid-point of the behavioural phase until the end of the study (see Figure 57).

In the final survey Grey selected *no* in response to all questions asking about difficulties with sleep.
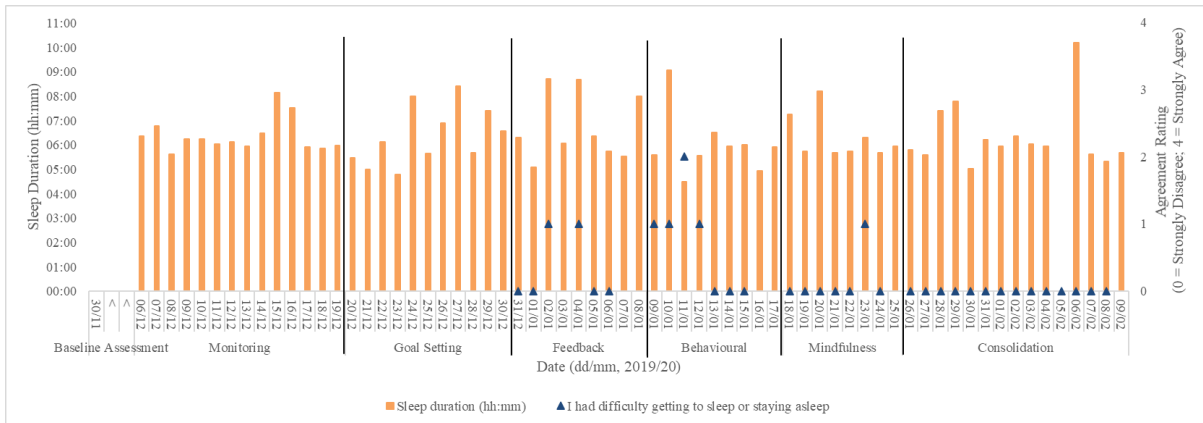
Figure 57: Grey sleep duration & daily measure agreement rating (I had difficulty getting to or staying asleep)

4.7.7 Goals

Grey's goal achievement ratings demonstrate improvements in both of his goals throughout the study (see Figure 58). The first improvements in achievement ratings can be seen following the behavioural phase, his first goal improves again during the mindfulness phase, and both improve during the consolidation phase.
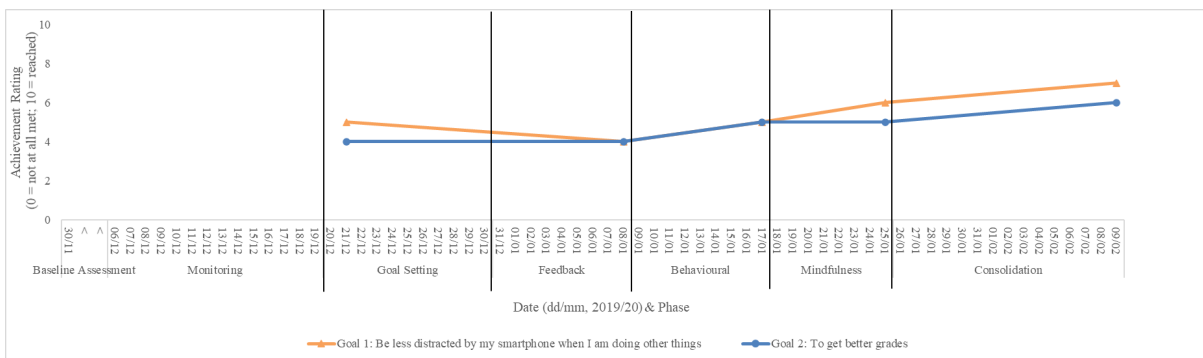
Figure 58: Grey goal achievement ratings

4.7.8 Change interview

The changes described by Grey during the interview are outlined in Table 18. Grey said that the practical tips (his description of the behavioural suggestions) and the mindfulness

practices were helpful. He reflected that he had tried some of the suggestions in the past, but they had not worked, or he had not stuck to them. He identified some specific examples of the tips he had tried during the study: "I keep like any notifications off and then when I do really [need to] concentrate on something just put it on flight mode… and then from the mindfulness er, aspect…like things like sort of these steps of noticing the urge you might have and let it pass or like do some breathing exercises", he went on to also speak about meditation and going for a mindful walk.

Grey described the feedback messages as interesting, and said that he would be interested in more of these, reflecting that seeing changes would be helpful, increasing his sense of achievement perhaps.

Table 18: Changes reported by Grey during interview

Description of change	Expectancy of change	How likely would it have been without the study	Importance of change
Being more productive and keeping to a schedule	Neither expected nor surprised by the change	Somewhat unlikely without the study (probably would not have happened)	Moderately important
A clearer mental state	Somewhat surprised by it	Somewhat unlikely without the study (probably would not have happened)	Very important
Having more time for in-person social interaction	Somewhat expected it	Somewhat unlikely without the study (probably would not have happened)	Very important

Grey was invited to reflect on what he thought had brought the outlined changes about: "I've had like a bad period from um . . . say sort of the beginning of last year until late summer. So it was kind of expected that I would sort of climb back again", he explained that he had some support from a psychologist, which had helped. He felt that both this support, and the study had been beneficial: "so the study kind of coincided…with this umm but it's definitely played a part in it". He explained that improving his mental state and managing feelings of

loneliness, boredom, stress and discomfort reduced his urge to spend time online and unintentional time of his smartphone. He said that he would have liked to have seen greater changes in his smartphone use, however; "like use my smartphone even less…or only use it whenever I intend to use it".

Grey said that he did not think he had changed the way he was using his phone. He said that the way he uses his phone is variable: "It might be time I spent intentionally…and doing like important stuff", or that he can pick up his phone and spend much more time using it than he intended.

Grey reflected that picking up his phone can be comforting and said: "improving my relationship with it is crucial". Grey spoke about being less distracted by his phone, and also the difference between internal and external triggers for using it: "it's not necessarily being distracted by the notifications, which is like an external trigger…it's more about the internal triggers that lead me to grab my phone".

Grey said that he would recommend the intervention to others and that he planned to continue using the strategies he had described as helpful (as above), as well as: "like using pen and paper rather than umm, the mobile phone".

4.7.9 Conclusion

Overall, the data shows improvements in problematic phone use, wellbeing and psychological distress, mindfulness, sleep, and Grey's self-identified goals. In addition, the change interview provides evidence of other areas of Grey's life that he believes to have been impacted: improved productivity and increased in-person social contact. The outcomes for Grey are likely to have been influenced by the therapy he accessed, which coincided with the study, although his change interview data demonstrates very specific examples of ideas he took from the study intervention.

4.8 Participant eight: Silver

Silver is a 20-year-old white European female in her second year of study in the School of Fine Art, History of Art and Cultural Studies. In the recruitment survey, she reported that the amount of time she spends on her phone had increased over the previous twelve months. She said that she was sure she spent more time on her phone than she should, and that she had previously tried unsuccessfully to cut this down.

During the change interview, Silver was invited to reflect on her reasons for participating in the study. She said that she was interested in finding out more about herself and how she

uses her phone, and particularly how her sleep was affected by her phone usage. She had noticed that her friends used their phones a lot but had then started to wonder how she compared to them. She said that her phone use was sometimes a problem when studying, or when at home with her family. Silver explained that her phone allows her to stay in touch with people who are not close by: "Well … I think what plays a huge part as well is that I am separate from my family and friends…So I tend to spend more time on Messenger or on Facebook when I talk to them…if they were around … that would have changed. Definitely. Because I would see them more often". Silver explained that prior to the study she would sometimes leave her phone in another room, and that she had turned off notifications, both of which she found helpful.

The baseline assessment placed Silver within the moderate range for dependence on the online world (as measured by the IAT). She scored above the clinical cut-off for psychological distress (as measured by the CORE-OM). The recruitment survey asked whether participants had problems with sleep in general, Silver selected *yes* to this question, as well as to having problems with feeling tired or unrested in the mornings.

Silver was allocated to complete the mindfulness phase followed by the behavioural phase.

Table 19: Silver pre-post measure scores

Measure	Pre	Post	Pre - Post	Direction of Change
MPPUS	144	119	25	Reliable Improvement
IAT	58[b]	49[a]	9	Improvement
MAAS	2.67	2.93	-0.27	Improvement
WEMWBS	29	36	-7	Improvement
CORE-OM	21.76[c]	21.76[c]	0.00	No change
BPNSS: Autonomy	27	25	2	Deterioration
BPNSS: Competence	12	13	-1	Improvement
BPNSS: Relatedness	\	26		

n.b. reliable indicates that the reliable change criteria was met
[a] *mild*
[b] *moderate*
[c] *above clinical cut-off*
\ *missing data*

4.8.1 Engagement

Silver reported that she had read all seven of the feedback messages and rated their usefulness 5/10. She reported trying two of the seven mindfulness suggestions and rated their usefulness 5/10. Of the behavioural suggestions, she reported trying none of the seven, but then entered in the comment box: "I don't remember at this point. I sometimes give them a try the moment I read them", she rated their usefulness 4/10. In the change interview Silver

said: "sometimes I would see the message in the morning and then forget about it". Silver completed 73% of the daily measures

4.8.2 Smartphone usage

A decrease in Silver's screen time median can be seen in the feedback phase, with increases in the two subsequent phases, and a slight reduction again in the consolidation phase (see Figure 59). There are also some *strongly disagree* ratings for feeling in control of smartphone use in this final phase, which are not seen in other phases (see Figure 59).

During the change interview Silver explained that her screen time was not always active usage, as she may leave her phone screen on playing music (whilst studying, for example). She also reflected on the impact of COVID-19: "In terms of my phone usage … maybe I started using it more but because of the virus and because I found myself … alone most of the time. So playing music, bring my phone anywhere so I can contact my family and friends. So my usage has actually increased but it wasn't because of the study". She also commented that the days her screen time is lower are likely to be days she was working.
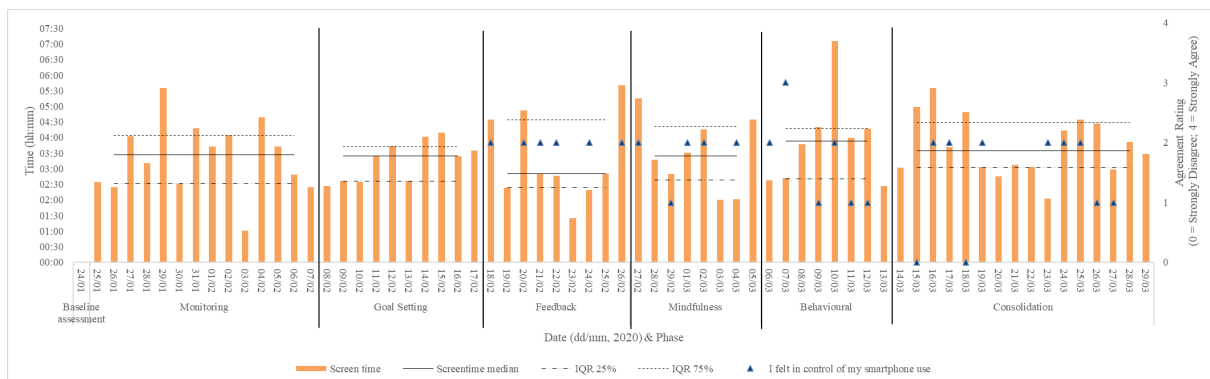
Figure 59: Silver daily screen time and daily measure (I felt in control of my smartphone use) rating

The MPPUS showed a reliable improvement in problematic use; the IAT also showed an improvement, although this did not reach the criteria for reliability (see Table 19).

The screen time data does not suggest a change in the time Silver spent on her smartphone between the start and end of the study, and her daily measure indicates feeling less in control, although she does give possible reasons for this. The MPPUS is indicative of an improvement in problematic use, and this is corroborated by Silver's self-report during the change interview (4.8.8).

4.8.3 Mindfulness

Silver's level of mindfulness (as measured by the MAAS) increased over the course of the study, but the change did not reach the threshold for reliability (see Table 19). The MAAS

and the daily measure fluctuate over the course of the study; the MAAS increased during the monitoring and feedback phases and decreased during the mindfulness and consolidation phases (see Figure 60). Silver reflected on this during the change interview, which she linked to COVID-19: "Hm. Well the mindfulness. It's just that circumstances now are like … crazy!...And I get distracted all the time.".
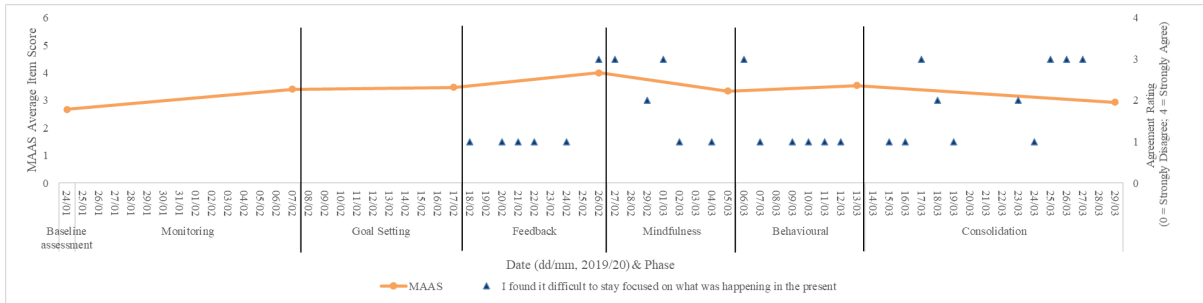
Figure 60: Silver MAAS and daily measure (I found it difficult to stay focused on what was happening in the present) rating

4.8.4 Wellbeing and psychological distress

The WEMWBS showed an improvement, although not reliable, and the CORE-OM showed no change for Silver over the course of the study (see Table 19). An improvement in the SWEMWBS can be seen in the monitoring phase, but it remains stable (fluctuating by just 2 points) for the remainder of the study (see Figure 61). Fluctuations are observed throughout the study in the daily measures relating to wellbeing and psychological distress (see Figure 62 & Figure 63).
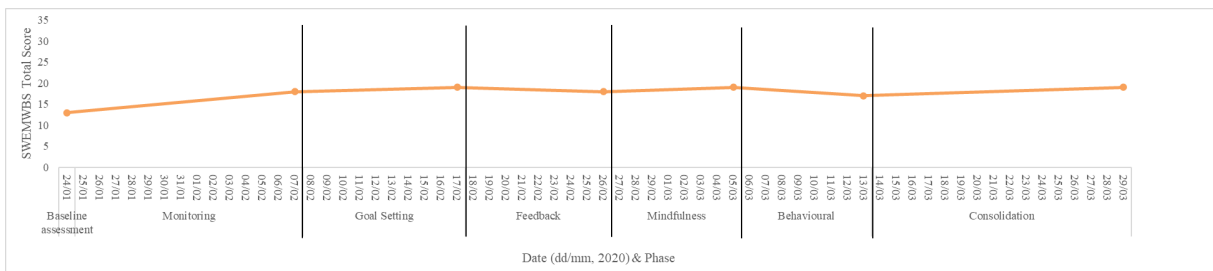
Figure 61: Silver SWEMWS Total Scores
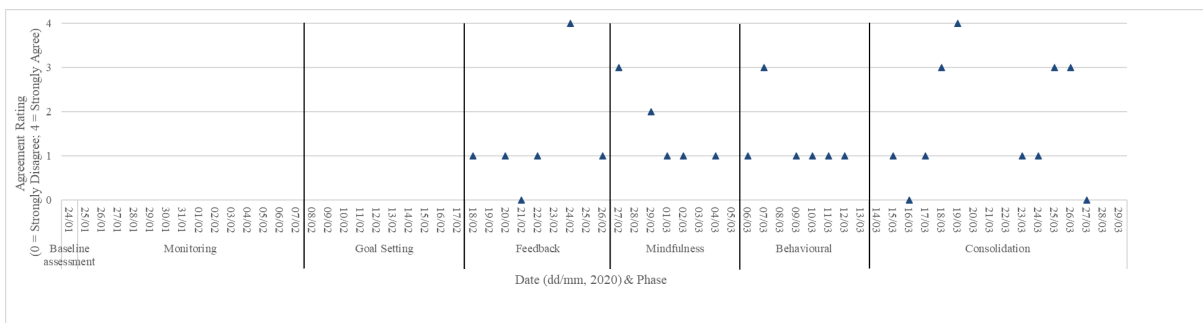
Figure 62: Silver daily measure (I felt unhappy) agreement ratings
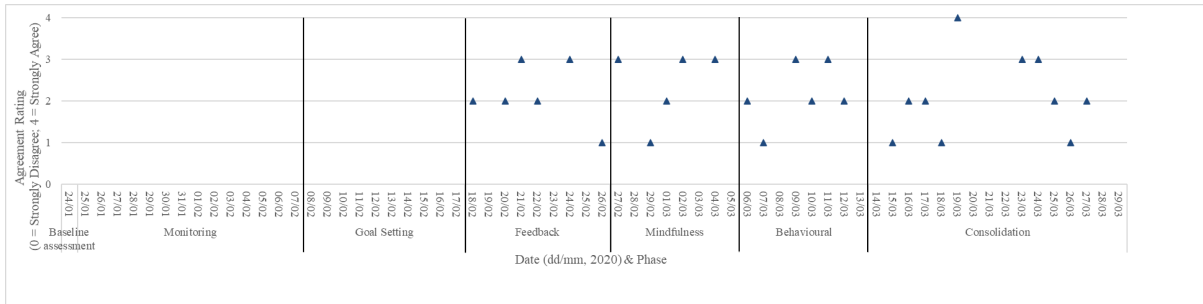
Figure 63: Silver daily measure (I felt close to other people) agreement ratings

4.8.5 Self-determination

Owing to missing data not all subscales of the BPNSS could be interpreted. The autonomy subscale showed a small deterioration, whilst competence showed a small improvement (see Table 19). The daily measure relating to sense of accomplishment showed a trend of reduced agreement throughout the course of the study (as seen in Figure 64).
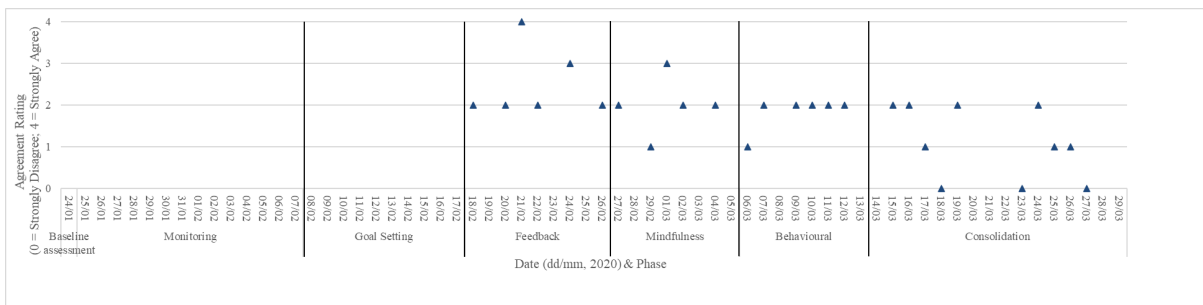
Figure 64: Silver daily measure (I felt a sense of accomplishment from what I did) agreement ratings

4.8.6 Sleep

Silver's sleep duration varies throughout the study, but on the whole sleep duration increases as the study progresses (see Figure 65). She reports less difficulty getting to or staying asleep in the final study phase (see Figure 65).

In the final survey Silver selected *no* in response to whether she had problems with sleep in general but selected *yes* to difficulty getting to sleep and feeling tired/unrested.
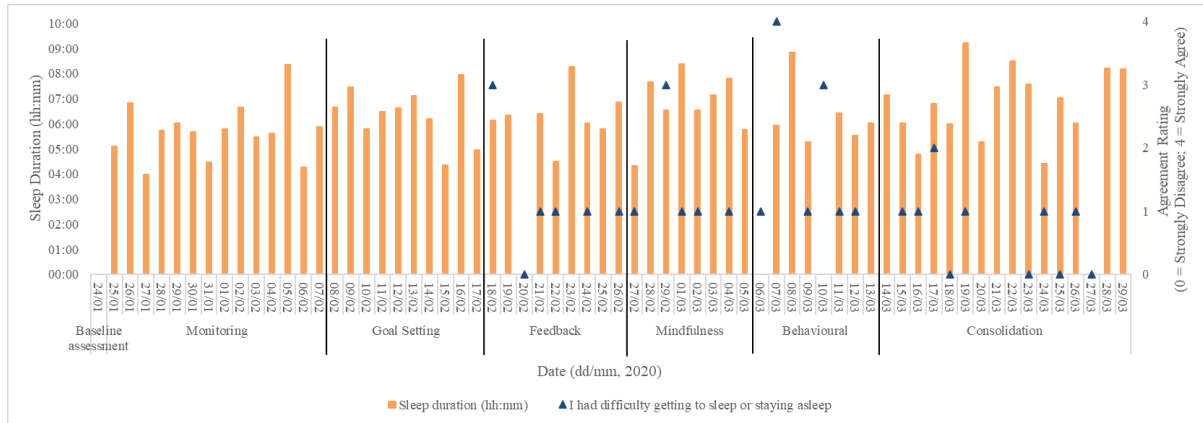
Figure 65: Silver sleep duration & daily measure agreement rating (I had difficulty getting to or staying asleep)

4.8.7 Goals

Silver's goal achievement ratings fluctuate and show only a small improvement overall (see Figure 66). There is an improvement in both goals following the feedback phase, and the behavioural phase. Silver's second goal of checking her phone less whilst studying reduces in achievement during the mindfulness and consolidation phases.
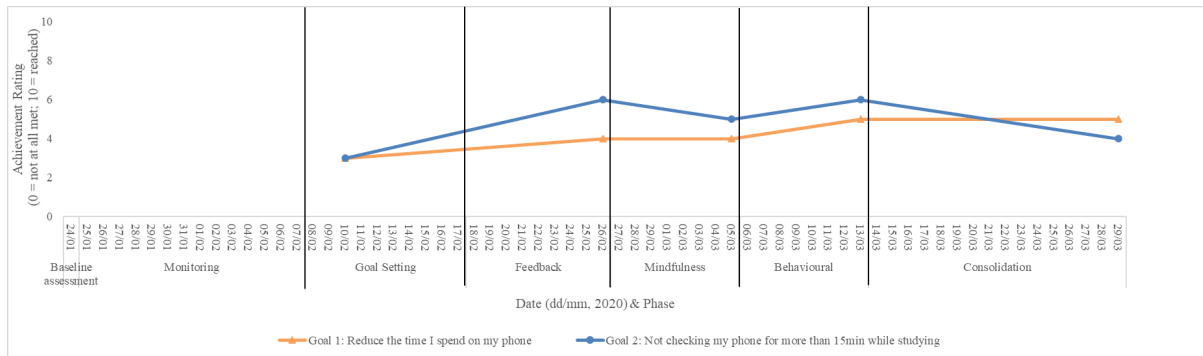
Figure 66: Silver goal achievement ratings

In the change interview Peach wondered if her ratings were a little underestimated: "I feel like I've improved on them both a bit. I feel like…in my mind when you get into 8, 9, 10 you're kind of like very nearly there. So…I feel like I was possibly just more hesitant to say that!".

4.8.8 Change interview

Silver identified the key change as awareness (see Table 20), this was awareness of both the time she was spending on her phone, and the reasons why. Silver expanded on this change, saying: "I'm a lot more conscious about my usage. Especially before I go to bed because … before the study I was like 'Oh just 10 minutes on my phone before I go to bed to make me fall asleep faster!' This is not the case! Definitely not the case!".

Table 20: Changes reported by Silver during interview

Description of change	Expectancy of change	How likely would it have been without the study	Importance of change
Increased awareness of phone usage	Somewhat expected it	Somewhat unlikely without the study (probably would not have happened)	Extremely important

When Silver was asked to what she attributed the change, she said: "Well the first thing, I think even before the study again was my friends, just seeing them … em and comparing myself and my usage to theirs. Em after that, during the study, I think just looking at the results because I could, I could sometimes see how much time I spent because of the messages…So this was a very motivating thing, just to have in mind how many hours I spent on my phone.". Silver also said that she enjoyed completing the daily surveys and found the FitBit data interesting.

Silver confirmed her difficulty in engaging with the intervention: "Well the messages…I continually ignored them! Or forget about them…this wasn't always the case but… most of the time it was". Silver was asked what determined whether or not she engaged with the suggestions, she said that this was circumstantial (e.g. what she was doing at the time she received the notification). When asked what might have helped with this, she suggested reminders, which perhaps asked whether you had tried the intervention yet, with a negative response triggering another reminder. Silver commented that the study required her to use her phone and said that she thought the intervention might be improved if a laptop could be used instead.

Silver said that she would recommend this intervention to others and that she plans to continue using some of the suggestions. She has become more motivated to leave her phone in different rooms or go out without it, she plans to turn her notifications off, and she wants to continue to not use her phone before she falls asleep. She reflected on her attempts at using these ideas: "They did change things but very strangely, because you're so used to using your phone…you may try it one day and fail another.".

4.8.9 Conclusion

Overall, the data suggests that there were some improvements in problematic phone use and possibly sleep for Silver. The key change described by Silver was increased awareness, which motivated her to make other changes. Silver's level of engagement with the

intervention appeared to be low; the between phase surveys suggest that she tried only two of the suggestions and that she did not find them particularly useful. Despite this, Silver gave examples of ideas she planned to continue using.

4.9   Participant nine: Peach

Peach is a 21-year-old white British female, in her fourth year of study in the school of chemistry. In the recruitment survey she reported that the amount of time she spends on her phone had not changed in the previous twelve months, that she thought about cutting down the time she spent on her phone, and that she possibly spent more time on her phone than she should.

During the change interview Peach was asked to reflect on her reasons for participating in the study. She said that she participated because it sounded interesting and that she thought she probably used her phone a bit too much. She said: "I feel like it's just, just like a habit that you get into and you know, use it before like bed and things like that or…sat doing some work and I kind of just look at my phone and then you waste half an hour.".

Peach scored within the mild range for dependence on the online world (as measured by the IAT) and scored above the clinical cut-off for psychological distress (as measured by the CORE-OM). The recruitment survey asked whether participants had problems with sleep in general, Peach selected *yes*. She also selected *yes* when asked if she had difficulty getting to sleep, waking during the night and too early, and with feeling tired/unrested in the morning.

Peach was allocated to complete the mindfulness phase followed by the behavioural phase.

Table 21: Peach pre-post measure scores

Measure	Pre	Post	Pre - Post	Direction of Change
MPPUS	91	123	-32	Reliable deterioration
IAT	35[a]	36[a]	-1	Deterioration
MAAS	3.07	3.00	0.07	Reliable deterioration
WEMWBS	29	40	-11	Reliable improvement
CORE-OM	20.88[b]	16.47[b]	4.41	Reliable improvement
BPNSS: Autonomy	27	27	0	No change
BPNSS: Competence	17	23	-6	Improvement
BPNSS: Relatedness	31	35	-4	Improvement

n.b. reliable indicates that the reliable change criteria was met
[a] mild
[b] above clinical cut-off

4.9.1 Engagement

Peach reported that she had read all seven of the feedback messages and rated their usefulness 10/10. She reported trying three of the seven mindfulness suggestions and rated their usefulness 3/10. Of the behavioural suggestions she reported trying one of the seven and rated their usefulness 6/10. In the change interview Peach said that where she had tried the ideas she had not tried them for very long. She reflected that a fear of missing something had got in the way of her making changes, but subsequently said she was unlikely to miss anything important. Peach completed 80% of the daily measures.

4.9.2 Smartphone usage

For Peach there is an increase in daily screen time throughout the course of the study (see Figure 67). The daily measure shows that Peach is feeling less in control of her smartphone use towards the end of her study participation (see Figure 67). In the change interview Peach reflected on the impact of COVID-19, saying: "I think I've probably definitely been more on my phone since I've been like stuck at home as it were!" and "I feel like in a way there's like less other things to do". She also reflected on some of the purposes of her phone at the present time: "I feel like, you know, probably spent like quite a lot of time like talking to people like, on like yeah Facetime or whatever.".

When looking at the data during the change interview, Peach reflected: "…surprises me a bit. I feel like it almost…hasn't kind of like all gone up as much as I expected in a way!".
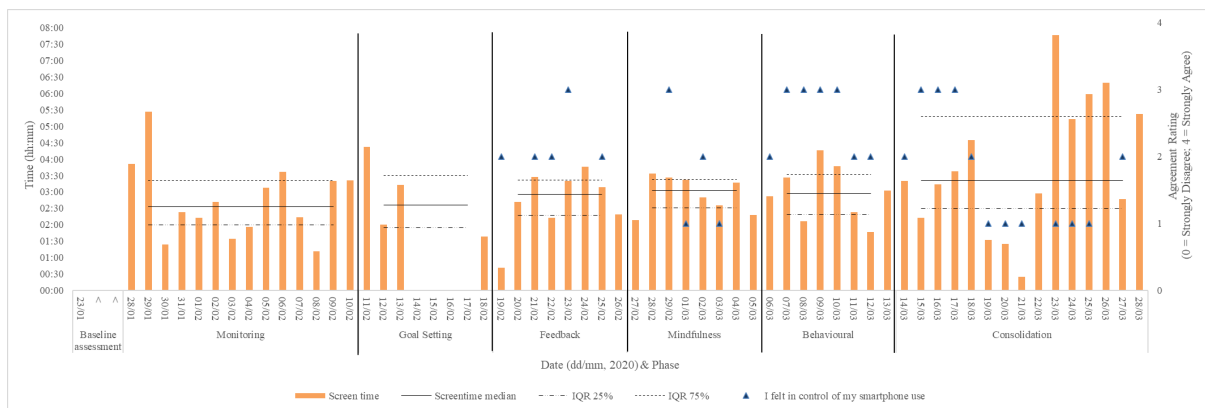
Figure 67: Peach daily screen time and daily measure (I felt in control of my smartphone use) rating

The MPPUS shows a reliable deterioration in problematic phone use, and the IAT also shows a deterioration in dependency on the online world (see Table 21). When Peach was presented with this data at the change interview she said: "I kind of expected both to go up in my mind. I think 'cause like with the last couple of weeks I've been using my phone a lot more.".

Overall, both the time Peach spends on her phone and her level of problematic use have increased over the course of the study.

4.9.3 Mindfulness

Peach's level of mindfulness showed a reliable deterioration over the course of the study (see Table 21). As shown in Figure 68, the MAAS reduced during the goal setting phase, and although it increased in subsequent phases it remained lower that at baseline. The daily measure is variable throughout, but there are more *agree* responses during the mindfulness and subsequent phases, and there are no *disagree* responses during the mindfulness or consolidation phases (see Figure 68).
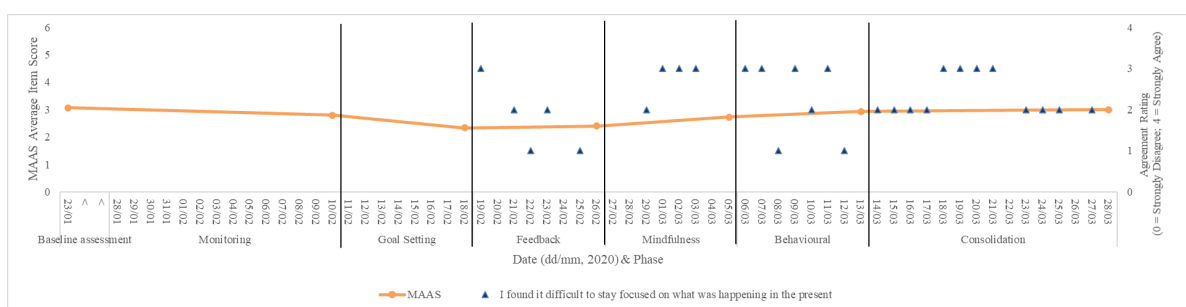
Figure 68: Peach MAAS and daily measure (I found it difficult to stay focused on what was happening in the present) rating

4.9.4 Wellbeing and psychological distress

Both the WEMWBS and the CORE-OM showed reliable improvements between the start and end of the study, the CORE-OM remained above the clinical cut-off (see Table 21). The SWEMWBS decreased during both the goal setting and mindfulness phases, but increased during all other phases, with the greatest increase in the feedback phase (see Figure 69).

There was less agreement with feeling unhappy in the feedback and consolidation phases (see Figure 70). The daily measure also shows that Peach felt closer to others during the feedback phase (see Figure 71).
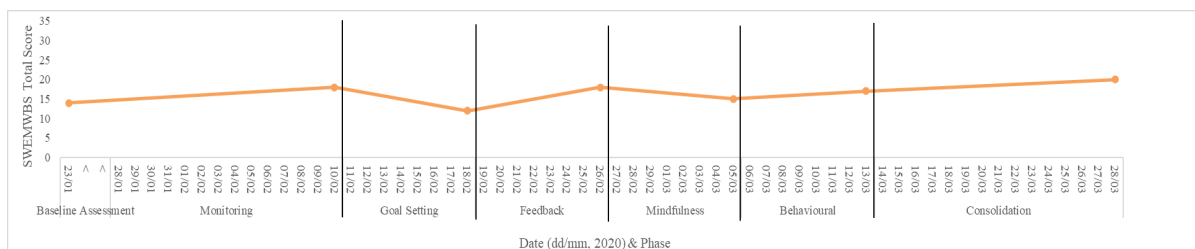
Figure 69: Peach SWEMWS Total Scores
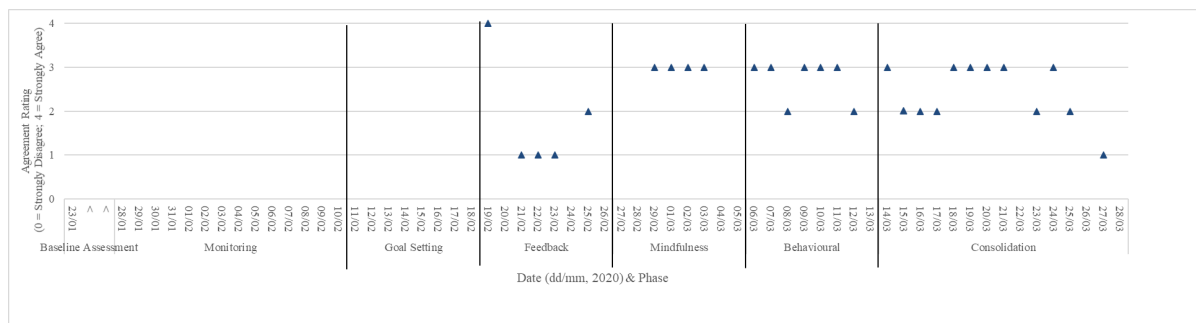
Figure 70: Peach daily measure (I felt unhappy) agreement ratings
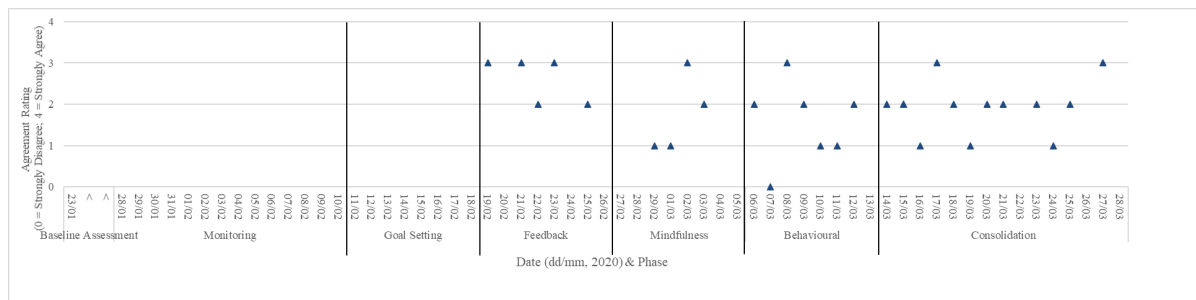
Figure 71: Peach daily measure (I felt close to other people) agreement ratings

4.9.5   Self-determination

The BPNSS showed improvements in competence and relatedness (see Table 21). The daily measure relating to sense of accomplishment (Figure 72) shows *strongly disagree* responses in the final phase, which is not seen in other phases.
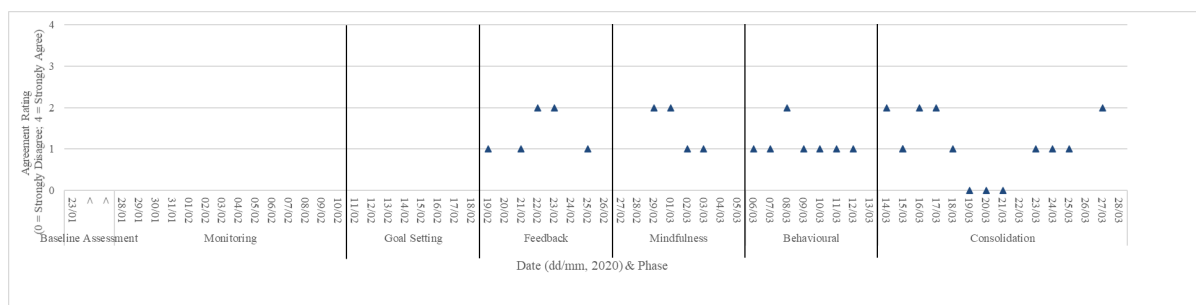
Figure 72: Peach daily measure (I felt a sense of accomplishment from what I did) agreement ratings

4.9.6   Sleep

Peach's sleep duration fluctuates throughout the study, and she reports less difficulty getting to or staying asleep in the final two phases (see Figure 73).

In the final survey Peach selected *no* in response to where she had problems with sleep in general but selected *yes* to difficulty getting to sleep and feeling tired/unrested.
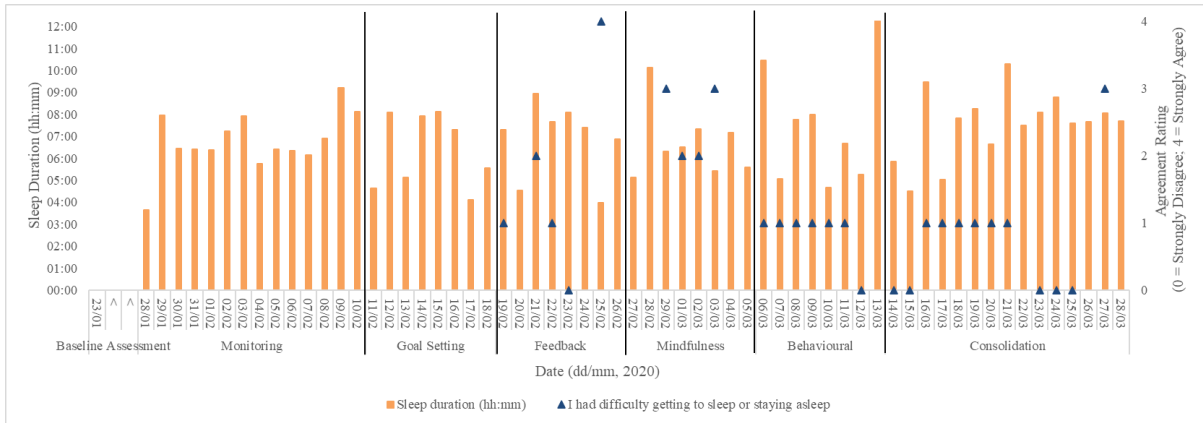
Figure 73: Peach sleep duration & daily measure agreement rating (I had difficulty getting to or staying asleep)

4.9.7 Goals

Peach's goal achievement ratings show only a small (1-point) improvement overall (see Figure 74). The achievement rating of both goals increases during the mindfulness and behavioural phases, but then subsequently decreases in the consolidation phase.
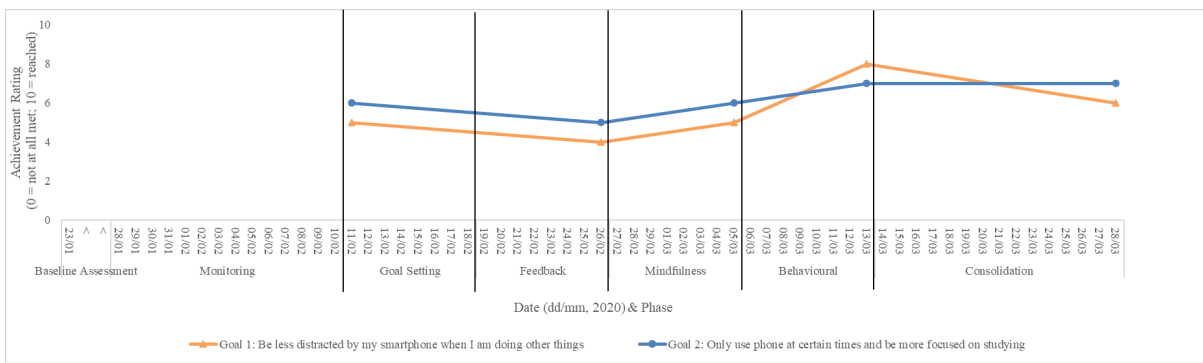
Figure 74: Peach goal achievement ratings

4.9.8 Change interview

Peach identified one change over the course of the study (see Table 22). When Peach was asked what specific ideas, if any, she had got from the study, she said: "the stuff like you know, like taking time, like noticing surroundings and stuff like being … more present in the moment rather than being like distracted by … other things.".

Peach felt that she had made some changes, but that she still spends a lot of time scrolling through social media, which she would have liked to have changed.

Table 22: Changes reported by Peach during interview

Description of change	Expectancy of change	How likely would it have been without the study	Importance of change
More aware of phone use and noticing when using it	Somewhat surprised by it	Very unlikely without the study (clearly would not have happened)	Moderately important

Peach felt that the feedback messages had brought her usage in to her awareness, but also that knowing she was being monitored had contributed. Peach said that the statistics she was sent during the feedback phase were the most helpful part of the intervention for her.

Peach said that she would recommend the intervention to others, and that she planned to continue using some of the ideas. When Peach was asked which strategies she planned to continue using she again mentioned the mindfulness practice. She reflected that the behavioural suggestions (e.g. turning off her notifications) felt like the biggest changes to make, and therefore the mindfulness ideas felt easier.

Peach felt that she had taken the first step to reducing problematic use: "I think yeah I'd probably like to make more changes. I think it probably would be…I think there's kind of like a bit of a difference between like being aware of it and acting on it so I think it would be probably… would be doing more…". Peach went on to give an example of turning off notifications as something she might try, and said that she felt she needed to be aware of her smartphone use in order to want to make changes.

In order to increase her chance of engaging with the ideas, she said that she would try building up gradually (e.g. the reduction of notifications), "I think it would probably be like starting with something that I felt was, was less important and then kind of building up from there?".

4.9.9 Conclusion

Overall, the data suggests improvements in wellbeing, psychological distress and sleep for Peach, but a deterioration in problematic phone use. Peach's reflections during the change interview indicate that she became more aware of her smartphone use, but did not yet feel able to make changes to it.

4.10 Participant ten: Lime

Lime is a 20-year-old white British female; she is in her third year of study in the School of Education. In the recruitment survey, she reported that the amount of time she spends on her phone had increased over the previous twelve months. She said that she was sure she spent more time on her phone than she should, and that she thought about cutting down.

During the change interview Lime was asked to reflect on her reasons for participating in the study. She first said that she was feeling very anxious at the time and wanted: "to just kind of bring that focus back onto … myself and … my wellbeing I suppose.". She reported thinking that she was on her phone a lot, and wondered if she would feel freer, and be more in the moment with what she was doing and thinking, without it. She said that before the study she could lose time whilst using her phone and could not detach herself from it. She also explained that her family would call her a lot, and this could lead to agitation as she would become involved in conflict. She also said that she sometimes used her phone to avoid other things, for example when life was busy and she did not want to face this.

Lime had found it difficult to reduce her smartphone use in the past, which she attributed to everybody around her using their phones. In an attempt to have some phone free time before bed she had tried charging her phone in the kitchen but said she would "just go back into the room and get it".

Lime scored within the mild range for dependence on the online world (as measured by the IAT) and scored above the clinical cut-off for psychological distress (as measured by the CORE-OM). The recruitment survey asked whether participants had problems with sleep in general, Lime selected *no*. However, she did say that she had problems with waking during the night or too early and feeling tired/unrested in the morning.

Lime was allocated to complete the mindfulness phase followed by the behavioural phase.

Table 23: Lime pre-post measure scores

Measure	Pre	Post	Pre - Post	Direction of Change
MPPUS	142	98	44	Reliable Improvement
IAT	41[a]	8	33	Reliable Improvement
MAAS	1.53	4.40	-2.87	Reliable Improvement
WEMWBS	33	56	-23	Reliable Improvement
CORE-OM	11.8[b]	6.5	5.3	Reliable Improvement
BPNSS: Autonomy	25	34	-9	Improvement
BPNSS: Competence	36	39	-3	Improvement
BPNSS: Relatedness	39	38	1	Deterioration

n.b. reliable indicates that the reliable change criteria was met
[a] mild
[b] above clinical cut-off

4.10.1 Engagement

Lime reported that she had read all seven of the feedback messages and rated their usefulness 7/10. She reported trying three of the seven mindfulness suggestions and rated their usefulness 7/10. Of the behavioural suggestions she reported trying all seven and rated their usefulness 8/10. Lime completed 78% of the daily measures.

4.10.2 Smartphone usage

The screen time recordings show that there was an increase in the amount of time Lime was spending on her phone during the mindfulness and behavioural phases; this decreases in the consolidation phase but remains higher than the monitoring phase (see Figure 75). The daily measure shows that Lime feels more in control of her smartphone use during the behavioural phase, and this is maintained (although to a lesser extent) during the consolidation phase (see Figure 75).

Lime reflected on the impact of COVID-19 during the change interview; "at the start of… lockdown and stuff, I was really bad on my phone", she spoke about frequently checking the news, as well as spending a lot of time playing a game.
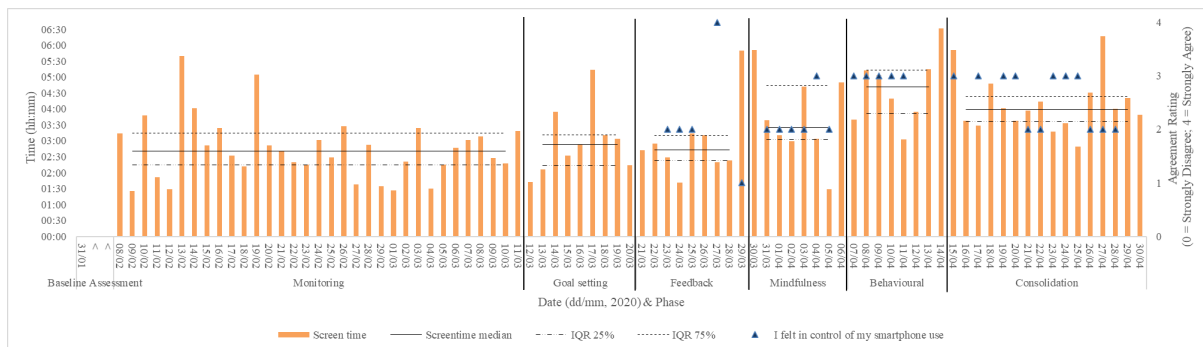
Figure 75: Lime daily screen time and daily measure (I felt in control of my smartphone use) rating

The MPPUS shows a reliable improvement in Lime's problematic phone use, and the IAT in dependency on the online world (see Table 23).

Although there is an increase in Lime's screen time overall, there is evidence of an improvement in problematic use, which was corroborated by the qualitative data collected during the change interview (4.10.8).

4.10.3 Mindfulness

As shown in Table 23, Lime's level of mindfulness (as measured by the MAAS) showed a reliable increase between the start and end of the study. The MAAS score increased over the course of the study; the improvements that occurred during the monitoring, feedback and

mindfulness phases all reached the criteria for reliable change (see Figure 76). The improvement during the mindfulness phase was the largest. The daily measure shows that there was increased difficulty with staying focused on the present in the consolidation phase (see Figure 76).
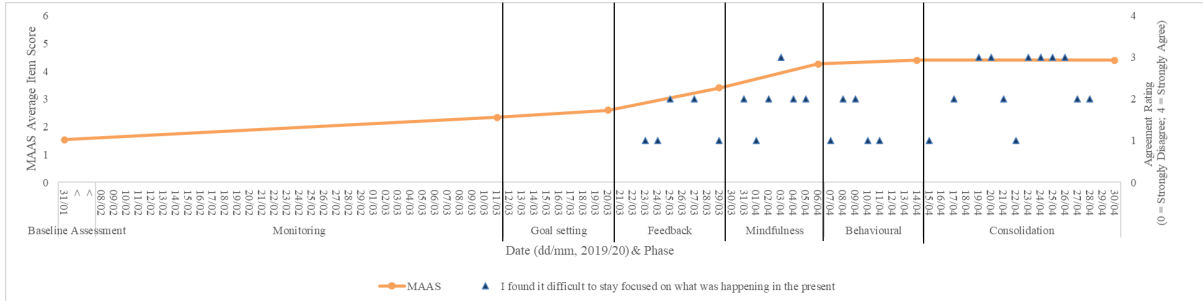
Figure 76: Lime MAAS and daily measure (I found it difficult to stay focused on what was happening in the present) rating

4.10.4 Wellbeing and psychological distress

Both the WEMWBS and the CORE-OM showed reliable improvements between the start and end of the study, the CORE-OM also moved below the clinical cut-off (see Table 23). The SWEMWBS increased by the greatest degree during the monitoring and mindfulness phases, there was a 1-point decrease during the behavioural phase (see Figure 77). Lime reflected in the comments box on the survey at the end of the behavioural phase that she had been feeling low due to the effects of COVID-19. The daily measures vary throughout the course of the study (see Figure 78 & Figure 79).
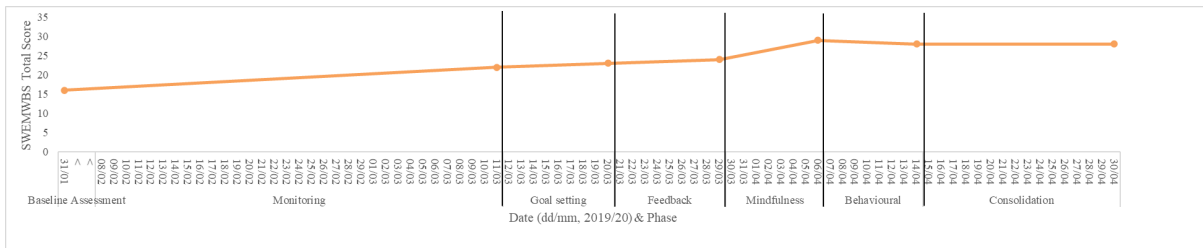
Figure 77: Lime SWEMWS Total Scores
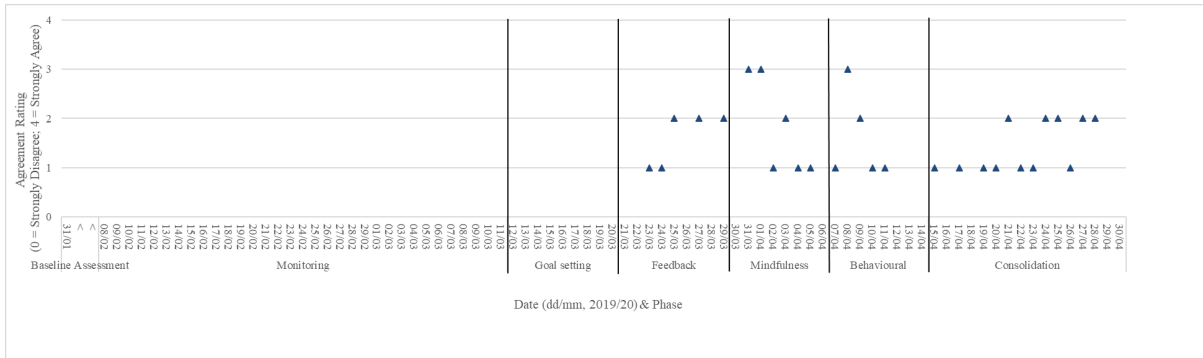
Figure 78: Lime daily measure (I felt unhappy) agreement ratings
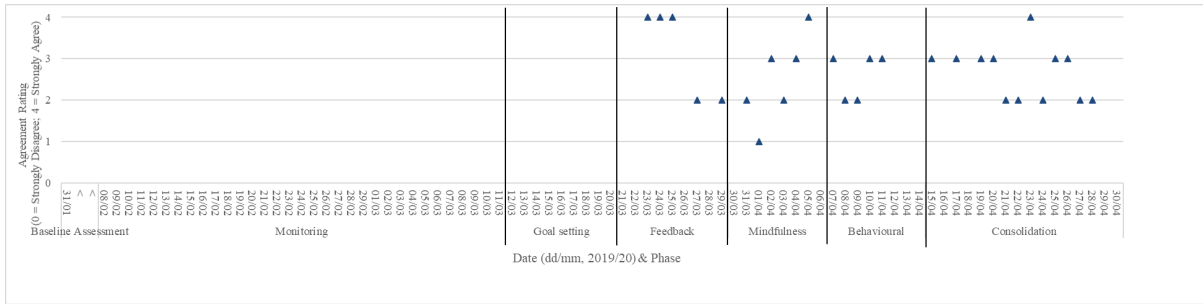
Figure 79: Lime daily measure (I felt close to other people) agreement ratings

4.10.5 Self-determination

The BPNSS showed improvements in autonomy and competence (see Table 23). The daily measure relating to sense of accomplishment (Figure 80) shows the highest frequency of *strongly agree* responses during the feedback phase.
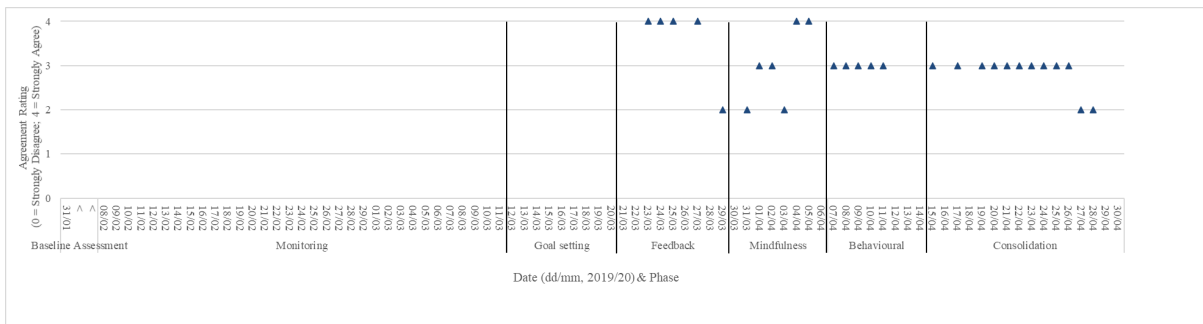
Figure 80: Lime daily measure (I felt a sense of accomplishment from what I did) agreement ratings

4.10.6 Sleep

Lime's sleep duration is fairly consistent across the first five phases of the study, and a little lower and more variable during the consolidation phase (see Figure 81). Lime reported difficulty getting to or staying asleep during the mindfulness and behavioural phases (see Figure 81).

In the final survey Lime selected *no* in response to whether she had problems with sleep in general but selected *yes* to difficulty getting to sleep and waking during the night.
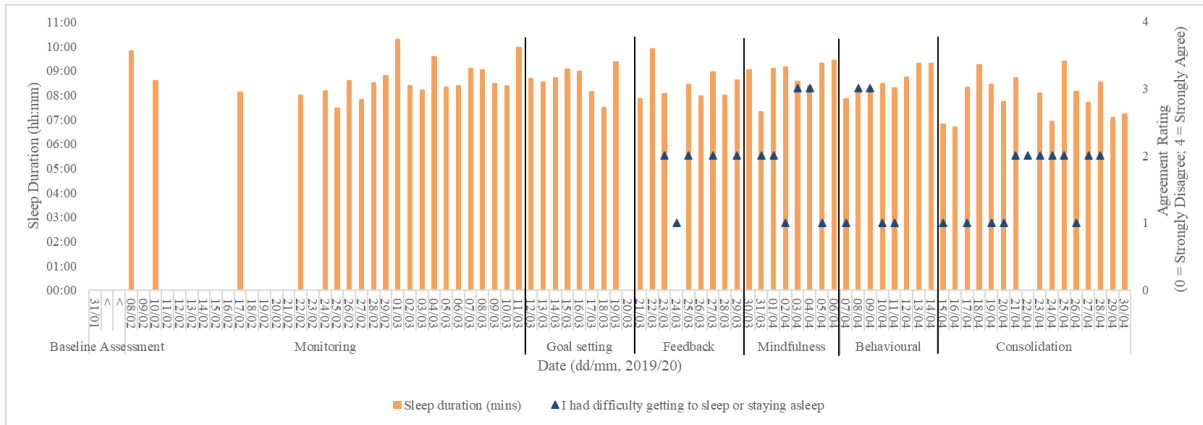
Figure 81: Lime sleep duration & daily measure agreement rating (I had difficulty getting to or staying asleep)

4.10.7 Goals

Lime's goal achievement ratings increase over the course of the study (see Figure 82). A sharp increase can be seen in the mindfulness phase, particularly for her first goal, which then decreases in the behavioural phase. Both goal achievement ratings increase again in the final phase, with both rated as 10/10. Lime stated that as her mood dropped during the behavioural phase (which she explained was due to COVID-19) her phone use also increased.
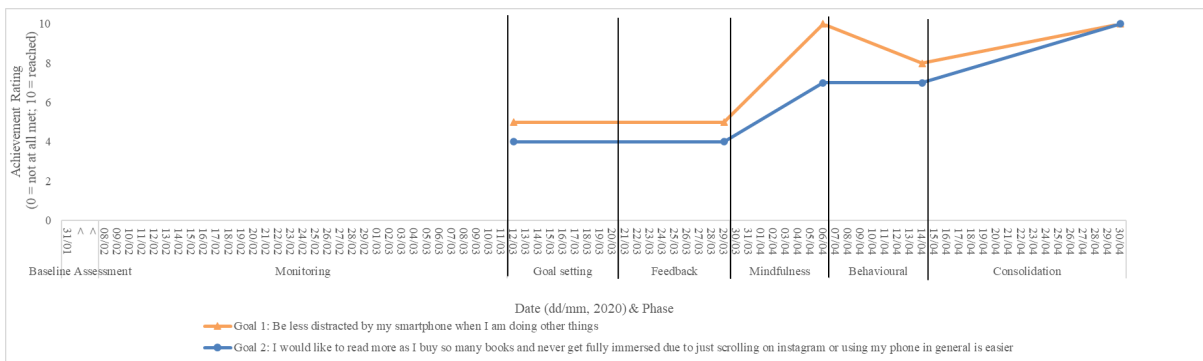
Figure 82: Lime goal achievement ratings

4.10.8 Change interview

The changes described by Lime during the interview are outlined in Table 24. Lime reflected on a process that she had already gone through earlier in the year, where her phone had become less important: "for me I think it's important to detach myself from it and realise that my life is my life. And that's my phone.".

Lime said that being monitored during the study was a motivator for her but that she made changes for herself and committed herself to the process. She found it helpful that the

intervention was delivered via an app on her phone, saying that it was an alternative to clicking on other apps, and one which she knew was going to be helpful and positive.

Table 24: Changes reported by Lime during interview

Description of change	Expectancy of change	How likely would it have been without the study	Importance of change
Being more mindful	Somewhat expected it	Somewhat unlikely without the study (probably would not have happened)	Extremely important
The ability to slow down	Very much surprised by it	Very unlikely without the study (clearly would not have happened)	Very important
Using alternatives to phone (e.g. reading books rather than reading on phone or listening to audiobooks; using watch rather than looking at phone clock)	Somewhat surprised by it	Very unlikely without the study (clearly would not have happened)	Extremely important
Feeling more in control (of phone use, and in general)	Somewhat surprised by it	Somewhat unlikely without the study (probably would not have happened)	Extremely important
Feeling more positive	Very much expected it	Neither likely nor unlikely (no way of telling)	Extremely important
Spending time without phone	Neither expected nor surprised by the change	Neither likely nor unlikely (no way of telling)	Very important

Lime felt that the combination of the behavioural and mindfulness ideas was important for her in making changes: "the mindfulness…I think I weren't really kind of aware of the

power of that as well. You know rather than just saying oh I'll leave it (phone) there and I'll come back. It's about thinking about what you're actually doing.".

Lime identified that she has learnt to choose when she uses her phone, and said that she felt less controlled by it. In relation to feeling in control, she made a comparison between how she previously used her phone to currently: "sometimes I go on Instagram and say I want to find an outfit inspiration or something, I'll just do that. Whereas prior to that I would probably spend hours on Instagram afterwards looking at other people…whereas I'm more focused on myself I would say now".

Lime reflected on the interaction between the changes she had made and her feelings in relation to COVID-19: "…I think everybody's feeling like a sense that…I suppose being thankful for the simpler things and I think like for me, leaving my phone and going for a walk has been massive thing in my day. And then I'll come home and I won't look at it for…maybe 30 minutes when we get in, whereas I would have never ever done that ever! Before now!". She said that she had never considered going out without her phone an option before. She felt that having the FitBit contributed to her ability to leave her phone behind, as it could replace some of her phone's functions (e.g. timing whilst exercising).

Lime said that she had found the intervention particularly helpful, given the COVID-19 lockdown. She explained: "as much as my smartphone use has kind of gone up and down, I would say that on the whole…I don't get that kind of like addicted feeling to my …I just use it when I want to use it…Whereas before I was busy and just using it to kind of push everything away. Whereas now I'm proactive at when, when I'm using it and why.". She said that her phone is no longer "another arm", reflecting on her ability to detach from it. But she also wondered whether she will be able to maintain the changes she has made when the lockdown ends and she returns to going out as she had done previously.

Lime said that she would recommend the intervention to others, and that she planned to continue using both the behavioural and mindfulness ideas suggested to her. She said that she thought it would be helpful to incorporate a prompt to reflect at the end of each day into the intervention. She said that she had used the daily surveys as a time to reflect, and that this had been helpful.

4.10.9 Conclusion

Overall, there is evidence of improvement in problematic phone use, mindfulness, wellbeing and psychological distress. Lime indicated full achievement of both of her self-identified goals and identified many positive changes in the interview.

4.11 Group level analysis

The following section considers what can be understood in terms of change over the course of the study, when the key outcome measures are explored collectively. Each of the key outcome variables are presented and analysed to determine whether there is evidence of change in response to the intervention (see Figure 83 & Figure 84). The results in relation to the study's aims and hypotheses will be explored in the discussion.
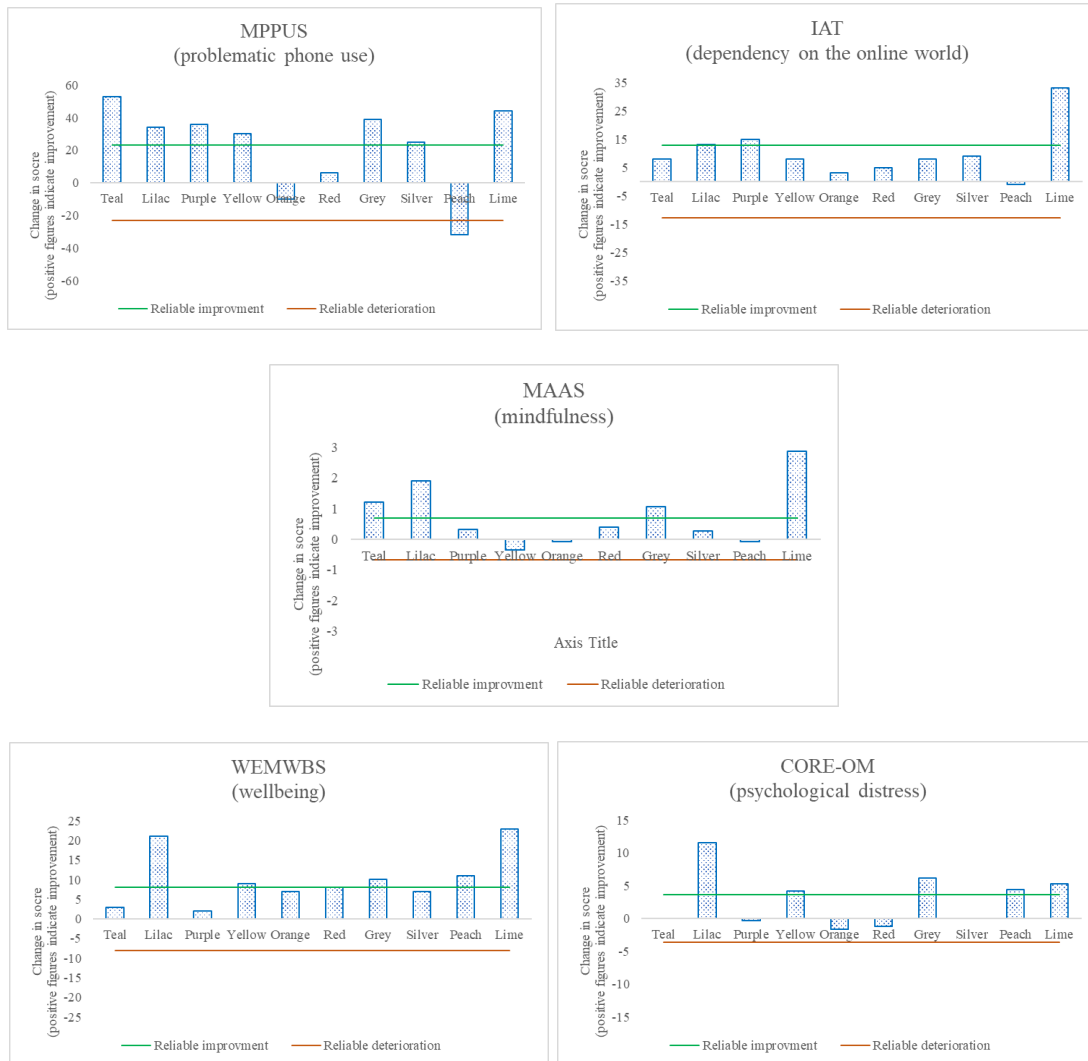
Figure 83: Changes in key standardised outcome measures over the course of the study for all participants
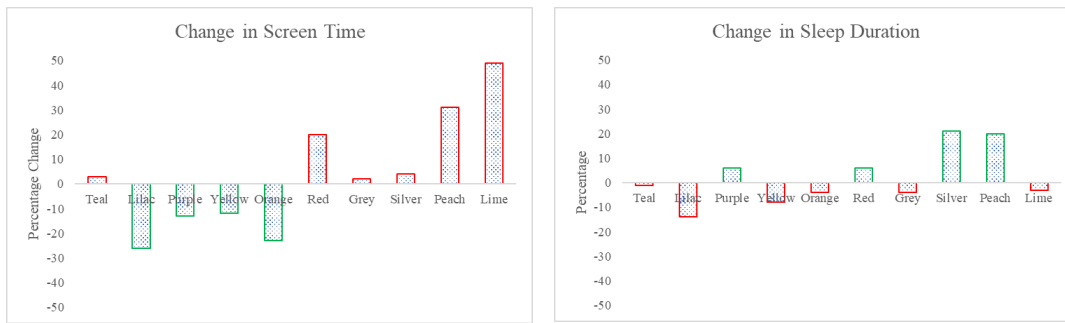
Figure 84: Percentage changes in direct measures over the course of the study for all participants (based on medians during monitoring and consolidation phases)

4.11.1 Smartphone use

Eight of the ten participants showed improvements in problematic phone use (according to the MPPUS), with all but one of those improvements meeting the reliability criteria. One participant showed a reliable deterioration on the MPPUS. The participant who showed the reliable deterioration, Peach, had explained in the change interview that she had found the behavioural suggestions too challenging to engage with, and that she planned to try making similar changes but in smaller steps following completion of the study. The IAT shows improvements in dependency on the online world for nine of the ten participants, with three of those changes meeting the criteria for reliability. A reduction in screen time was seen for four participants, three showed very small increases and three larger increases. The final three participants were engaging with the intervention during a period of COVD-19 lockdown, it was acknowledged by them in the change interviews that this may have resulted in increased smartphone use. There were three participants who made improvements on all measures associated with smartphone use.

The results confirm that the MPPUS and the IAT are measuring different concepts, and that although the IAT showed improvements over the course of the intervention, these were less pronounced than those made on the MPPUS for most participants. Further, they also suggest that problematic phone use does not equate to screen time; indicating that problematic use more likely relates to the way the phone is used and/or the relationship with it than the time spent using it.

The collective results demonstrate that for almost all participants there was an improvement in problematic phone use and dependency on the online world (as indicated by the standardised measures).

4.11.2 Mindfulness

There were improvements on the MAAS for seven of the ten participants, four of those changes reached the criteria for reliability. Increased awareness and/or mindfulness were also spoken about by many of the participants in the change interviews (4.11.5).

The results indicate that overall, there was a positive impact upon levels of mindfulness over the course of the study, although these changes were often small.

4.11.3 Wellbeing and psychological distress

Improvements in wellbeing on the WEMWBS can be seen for all ten participants, six of these reached the level for reliability. Improvements in the CORE-OM are seen for half the participants, all of which were reliable. Three participants spoke of wellbeing related changes in the interviews as key changes that had occurred.

Overall, there is evidence that wellbeing improved over the course of the study. There was an improvement in psychological distress for some participants, but not sufficient to conclude that there was an overall improvement.

4.11.4 Sleep

Eight of the ten participants reported an improvement in their sleep, with two of those participants identifying improvements in sleep as a key change during the change interview. For most participants, the duration of sleep did not change significantly over the course of the study. The individual analysis identified increased consistency in sleep duration for one participant.

Whilst sleep duration is important, disturbance and restfulness are also key in sleep problems (Devine, Hakim, & Green, 2005), which were not directly analysed in this study, but indicated via the survey data. The survey data is suggestive that some improvements were made, but the extent of these changes is unclear.

4.11.5 Goals and other changes

Eight of the ten participants had tried to make changes to their smartphone use previously and had either been unsuccessful or were unsatisfied with the changes they had made. For some participants previous changes were specific to a situation (e.g. whilst studying for exams), leading to reflections that they were capable of making such changes.

Over the course of the study, all participants reported an improvement in the achievement of their self-identified goals. These improvements were seen in goals relating to both changing

their smartphone use and improving another area of their life impacted by their smartphone use (e.g. studying).

In the change interview participants were asked to identify any changes that had occurred over the course of the study. Participants reported between one and five changes, and all participants rated at least one of those changes as either *somewhat unlikely* or *very unlikely* without the study. There was only one negative change reported, which was increased guilt relating to awareness of phone use. Five participants specifically reported a change related to increased awareness of phone use; although this was implicit in most of the change interviews, some participants described it as a contributor to other changes, rather than describing it as a change itself. Six participants described changes that related to phone use; these included reducing phone usage, having time away from their phone, and being less distracted by their phone. Changes suggestive of increased mindfulness were listed by four participants, and changes suggestive of improved wellbeing by three.

This data supports the changes detailed in the other sections; as well as evidencing that participants made changes that were meaningful to them. The data also provides evidence that participants attributed some of the changes made to the intervention delivered.

4.11.6 Conclusion

The results provide convincing evidence for improvements in problematic phone use, as well as some evidence for improvements in dependency on the online world, mindfulness, wellbeing, and sleep, over the course of study participation. Changes in screen time were variable, and there was no clear pattern relating to the other measures. Based upon the individual data, there was no clear pattern of change occurring in a particular phase, nor different responses to the different parts of the intervention.

5   Discussion

5.1   Summary

This case series evaluated a light-touch digital intervention for problematic smartphone use. The participants were ten undergraduate university students presenting with mild to moderate levels of dependency on the online world. The outcome measures indicate significant improvements in problematic phone use and wellbeing for the majority of participants over the course of the study, improvements were also seen in dependence on the online world and mindfulness for most participants. Half the participants showed reliable improvements in psychological distress. There was some indication of improved sleep, although the extent of this could not be determined. Consistent changes were not observed in direct measures of screen time. The qualitative data collected during the change interviews supports the findings. The discussion will explore these findings and possible attributions for them, paying attention to whether there is sufficient evidence to attribute the changes to the intervention itself, and determining whether there is sufficient evidence for the study's hypotheses.

The findings will first be considered in relation to the research aims and hypotheses, followed by an exploration in relation to the existing literature and of clinical implications, identification of strengths and limitations, and finally reflections on possible future research.

5.2   Revisiting aims & hypotheses

The main aim of the research was to evaluate the acceptability and effectiveness of a light-touch intervention for problematic smartphone use. Based upon the engagement of the study participants, and the answers given during the change interview (all participants said they would recommend the intervention to others), there is evidence that the intervention is acceptable. Although all participants felt the intervention was acceptable in the way it was delivered, some did suggest alternatives. Three participants suggested the intervention would have been better delivered away from their phone, using an alternative device or face-to-face contact. Contrary to this, one participant thought the phone delivery was an advantage (as it meant there was something helpful to click on as an alternative to other notifications). It was clear that participants did not engage with all aspects of the intervention; there were many reports of participants trying two or three of the seven suggestions made in both the

mindfulness and behavioural phases. Despite participants choosing not to try all of the suggestions made to them, they continued to engage with the study overall.

It seems that the intervention is acceptable, but this conclusion is reached with caution. All participants were reimbursed for their participation, which may have influenced their willingness to engage. Although, participants were of course free to choose whether to try the suggestions or not; all participants chose to try at least some of them, and stated that they would recommend the intervention to others.

The effectiveness of the intervention is considered in relation to the first hypothesis, the remaining hypotheses are subsequently explored.

5.2.1 Hypothesis 1: the intervention package will reduce problematic smartphone use

The findings show clear evidence of a reduction in problematic phone use over the course of the study for the majority of participants. There was also a reduction in dependency on the online world. The results did not show a consistent change in screen time over the course of the study for the participants. Whilst this suggests that the intervention is effective for reducing problematic use, it also confirms that problematic use is a complex concept (see 5.3.1 for further exploration). Previous research in students has resulted in mixed findings; some studies found that the severity of problematic smartphone use was related to screen time but not frequency of use (Loid, Täht, & Rozgonjuk, 2020; Rozgonjuk, Levine, Hall, & Elhai, 2018), whilst other studies have found a correlation only with frequency of use (Lee, Ahn, Choi, & Choi, 2014; Lin et al., 2015).

For the current participants, problematic use did not equate to time spent on their smartphones. In interviews they highlighted their perceived ability to control their phone use, and the impact it had on other areas of their lives, as more important than the time spent on their phone. As such, the MPPUS was considered to be the best measure of problematic use in the present study.

The two participants whose measures indicated a worsening in problematic phone use described increased awareness of their phone use in the change interview. There was one participant who showed a reliable deterioration in problematic phone use (Peach), as well as a small deterioration in online dependency; this might be explained by her reflection in the change interview that she had been unable to use the behavioural suggestions as they were too difficult. Orange showed a smaller deterioration in problematic phone use, as well as in improvement in online dependency. She identified one change as a reduction in her phone use, which is reflected in the screen time data; this fits with the theory that problematic use

equates to more than just screen time. Orange had been able to reduce her phone usage but was still experiencing behaviours, thoughts or feelings associated with problematic use.

Almost all of the participants described changes in the interview which reflected increased awareness of their phone use, and/or positive changes in the way they were using their phone. The two participants who did not describe changes such as these both described a related change (increased face-to-face interaction, instead of remote interaction).

All participants said that either the intervention overall, or specific elements of it, had contributed to the changes they had made. This supports the ability to make causal inferences; it is known not only that changes occurred over the course of the study, but also that participants attributed these changes to the intervention, and to specific ideas gained from the intervention (see Elliott, 2002). One participant (Grey) was accessing concurrent psychological therapy, although he identified specific elements of the study that had contributed to the changes he had made, and stated that both it been beneficial, it is not possible to be sure of the level of contribution.

Most of the participants reported having tried to make changes to their smartphone use prior to the study which had been unsuccessful to some extent. This suggests that the intervention had importance in facilitating change, given that participants had been unable to make the changes independently. However, it is possible that expectancy influenced the results; individuals may believe and report change because they are expecting it to occur (see Elliott, 2002). This is important given the finding that problematic use cannot be measured via screen time, meaning there is no wholly objective measure. Expectancy is difficult to rule out altogether, however, participant responses within the change interviews provide useful information. Eight of the participants described a mixture of changes they expected and those that they did not; some expected to see increased awareness of phone use but no behavioural change, for example (or vice versa). Of the two participants who reported a single change – increased awareness – one somewhat expected this, and the other was somewhat surprised by it. Additionally, there were examples of participants providing descriptions using idiosyncratic language, describing changes that did not obviously fit with the broad focus of the study, and describing negative changes. The change interview data supports the conclusion that the changes are true experience-based descriptions.

Overall, the evidence supports the hypothesis that the intervention package reduces problematic smartphone use.

5.2.2 Hypothesis 2: mindfulness will increase as smartphone use becomes less problematic

Most of the participants showed improvements in levels of mindfulness, although only four of these met the reliability criteria. Four participants listed mindfulness as a positive change in their interview; participants also made links between mindfulness and improved problematic smartphone use. There is evidence to support the intervention having a positive impact upon mindfulness, and that for some participants there was a link whereby one benefitted the other (i.e. reducing problematic phone use increased mindfulness, or increased mindfulness had a positive influence on problematic phone use). There is insufficient data to conclude that the two improve simultaneously; for some participants there seemed to be a relationship, which was possibly an interaction, whereas for others there was no relationship between improvements in these two variables.

Overall, the results provide insufficient evidence in support of the hypothesis that mindfulness will increase as smartphone use becomes less problematic.

5.2.3 Hypothesis 3: wellbeing will improve as smartphone use becomes less problematic

The findings suggest that all participants' wellbeing improved over the course of the study. Whilst there is evidence of wellbeing improving over the course of the study, the data does not provide sufficient evidence of this being directly linked with improvements in problematic phone use (as measured by the MPPUS), given that some participants showed improvements in one and not the other.

Overall, the results provide insufficient evidence in support of the hypothesis that wellbeing will improve as smartphone use becomes less problematic.

5.2.4 Hypothesis 4: psychological distress will reduce as smartphone use becomes less problematic

The findings in relation to psychological distress are inconsistent across participants; whilst there were changes that met the reliability criteria for half the participants, there was very little change seen for the remaining five.

Overall, the results provide insufficient evidence in support of the hypothesis that psychological distress will reduce as smartphone use becomes less problematic.

5.2.5 Hypothesis 5: sleep will improve alongside the improvements in wellbeing and reductions in problematic smartphone use

The sleep data recorded via the FitBit indicated fluctuations in sleep duration throughout the course of the study for most participants. There were self-reported improvements in sleep for almost all of the participants, with two identifying it as a key improvement in the change interview. Again, although there was evidence of improvements in sleep, no clear relationship between the changes in sleep, and the changes in problematic phone use was evidenced.

Overall, the results provide insufficient evidence in support of the hypothesis that sleep will improve alongside improvements in wellbeing and reductions in problematic smartphone use.

5.3 Interpretation of the findings in relation to the literature

5.3.1 Understanding problematic use

Participants in the present study described their smartphones as simultaneously useful and potentially problematic. One of the benefits described was maintaining social contact (with friends, and particularly with family where the participant had moved away for university). A number of participants spoke of accessing university communication on their phones and two specifically stated using their phones for academic studies, with one not having a laptop/PC at home. Similar to previous research (Young, 2010), this suggests that management is important (rather than abstinence), and that students are at particular risk, owing to their greater reliance on their smartphones.

The main reason identified within this study for wanting to make changes to smartphone use related to studying, followed by relationships with others, and relaxation and leisure time; all of which participants felt their smartphone interrupted. Interestingly, these were areas in which participants also described using their phones in useful ways (i.e. accessing academic material, maintaining contact with family and friends, playing games). This emphasises that the relationship individuals have with their phone is complex; not only is it beneficial and problematic overall, but it can be both beneficial and problematic for the same purpose (i.e. it aids studying, but also interferes with studying).

The present study provides evidence that problematic phone use is multifaceted; it relates not only the time one spends on their phone, but to the control they feel they have over their usage, and the extent to which it interferes with other areas of their life. Previous research

findings have been inconsistent in relation to the relationship between problematic use, frequency of use and duration of use (Lee et al., 2014; Lin et al., 2015; Loid et al., 2020; Rozgonjuk et al., 2018). The present study found no direct relationship between the changes participants made in the amount of time they spent on their phones and the changes that were seen in their level of problematic use. Participants described important aspects of improving problematic use that related to characteristics other than screen time, these included: feeling more in control of their phone use or reducing the urges; being less distracted by their phone; and reducing the impact their phone had on other areas of their life (e.g. socialising, studying). Two participants expressed surprise that their smartphone use had not reduced, one explicitly stated that she was disappointed by this. One participant expected her usage to have increased more than it had (as a result of the COVID-19 lockdown). This suggests participants were not able to accurately estimate their smartphone usage, as has been found previously (Lin et al., 2015).

The reasons participants gave for using their phones (beyond those which are practical) overlapped with some of those already described in the literature, they included: boredom, avoiding difficult feelings, lack of motivation (to do another task or activity) and habit (Oulasvirta et al., 2012; Panova & Lleras, 2016). The majority of participants chose studying as the area of their life they wanted to improve as a result of better managing their smartphone use; the goals were often linked to not being distracted whilst studying. The idea of being distracted by one's smartphone was also described by participants during the change interviews, participants spoke of being drawn to their phone when engaging in other activities. These findings fit with previous research detailing the tendency to be automatically drawn to our phones, even when they do not require our attention (Peper & Harvey, 2018). One participant showed insight into the difference between internal and external cues, identifying that the internal urge may exist without an external cue (i.e. a notification). Another participant described the anxiety she feels when her phone is not in sight, and feeling unable to leave the house without it, this is reflective of the separation anxiety that has previously been discussed in the literature (Clayton et al., 2015).

Previous literature has discussed the possible loss of social skills owing to the heavy use of, and increased reliance on, technology (Montag & Walla, 2016). In the present study participants reflected on replacing face-to-face contact with remote contact and being less present during face-to-face interactions when using their phones. Participants also noticed that others are less present when they are using their phones and reflected on how difficult it is to connect with somebody who is using their phone. Two participants reported increased face-to-face contact alongside better management of their problematic phone use. One participant also highlighted that her phone meant she was unable to avoid more difficult

interactions, as she was always contactable (although this changed over the course of the study, with her feeling able to choose when to use her phone by the end).

The findings are consistent with descriptions of problematic use being characterised by salience, compulsive use, withdrawal symptoms, escapism, negative outcomes, mood regulation and social comfort (Lortie & Guitton, 2013). The relationship between problematic use, screen time and frequency of use is complex; this relationship remains unclear in the present study.

5.3.2 Intervention for problematic use

The intervention package delivered in the present study was derived from the research focusing on problematic use of technology and the internet, as well as drawing upon what we know about intervention with other problem behaviours. The package comprised of multiple phases (goal setting, personalised feedback, mindfulness, and behavioural suggestions). The findings of this study suggest that the intervention package was effective. The changes observed could not be attributed to any one phase; participants' reflections suggested that the combined intervention was important. The remainder of this section will consider the different intervention phases.

People are often unaware of when their technology and/or online use becomes problematic (Lee, 2018; Turner et al., 2016), suggesting that increasing awareness might be important. Until very recently, there had been no evaluation of the impact of offering feedback on problematic smartphone use. A very recent study has found that offering feedback alone had no impact upon level of problematic use, and resulted in only a small (not statistically significant) reduction in screen time (Loid et al., 2020). Although these preliminary findings suggest feedback is ineffective, it may be the case that increased awareness enables somebody to progress through the stages of change (Prochaska & Norcross, 2001), increasing the likelihood of future behaviour change. In the present study all participants reported an awareness that their phone use was problematic prior to participation; this awareness was a necessary prerequisite, given that somebody must recognise a problem in order to want to make a change. Despite all participants in the current study having this prior awareness, many reported increased awareness over the course of the intervention, some specifically linking this to the personalised feedback messages they were sent. This suggests that whilst participants had an awareness, they were perhaps under-aware (Prochaska, DiClemente, & Norcross, 1992), especially given that we know people tend to underestimate their usage (Lin et al., 2015).

The current findings suggest that increased awareness often enabled or facilitated behaviour change. For participants where change was not evidenced, it appeared that the increased

awareness was a necessary first step. Whilst the participants already identified a problem, some spoke of the shock-factor of the statistics they received. Some participants were surprised by the duration or frequency (e.g. the number of times they used a particular app in a day) of their usage, others by how this translated into the bigger picture (i.e. how many days out of a year were taken up by phone usage). Some participants did suggest that it would have been helpful to receive an update on their smartphone usage at a later point in the study, commenting that this may have impacted on motivation. This is one way in which the feedback part of intervention could be developed, with an aim of maintaining the level of awareness and motivation, and perhaps maintaining behaviour change (see DiClemente, Marinilli, Singh, & Bellino, 2001).

Seven of the ten participants stated (or implied, through examples) that both the mindfulness and behavioural elements of the intervention were helpful, and/or that they planned to continue using them. There were two participants who highlighted only behavioural ideas as helpful. One participant explained that she had only tried the mindfulness suggestions, because the behavioural ones were too difficult. One participant suggested that it would be beneficial for all three of the phases to be integrated. Given that there was no clear pattern of change occurring during a particular phase, nor a pattern described by participants in the change interviews, the findings do not suggest that one element is more helpful than another. The participants' reflections on which types of intervention messages were helpful, and/or which they planned to continue to use, suggests that that there is benefit in multi-approach interventions. The current findings are in line with previous suggestions for interventions in problem behaviour outlined in the introduction, for behavioural intervention (Linehan, 2014; Young, 2013) and mindfulness (Feldman et al., 2011; Linehan, 2014; Shonin et al., 2014).

The mindfulness suggestions were focused on bringing somebody's focus into the present moment, whilst the behavioural suggestions focused on bringing it away from their phone. Although we are unable to identify how the separate intervention phases impacted differently on behaviour, we do know that both online and offline behaviours were influenced for most participants. The importance of focusing on online and offline behaviours has been emphasised in the internet addiction literature (Young, 2013), and also fits with the concept of approach goals (moving towards something positive) being influential (Wollburg & Braukhaus, 2010). Making changes in both areas was important for the participants in the present study.

The present study did not include cognitive intervention, which is included in the CBT-IA protocol (Young, 2011). Young suggests that cognitive restructuring addresses denial, and combats rationalisations, of problematic use. Some participants in the present study identified beliefs they held about their smartphones (e.g. that they would miss something

important if they did not have their phone to hand, or that their phone would help them sleep). The participants reported a shift in these beliefs (or rationalisations) over the course of the study. We can derive from this that for some participants, their learning from making behavioural changes allowed for beliefs to be challenged; this is consistent with other CBT research (Longmore & Worrell, 2007). Further, it is likely that unhelpful thoughts relating to phone use not being a problem (denial) would have been directly challenged by the feedback. It is also possible that increased mindfulness enabled participants to manage their thoughts differently, one participant described thinking about her phone less, for example. It is not clear whether a cognitive element would have enhanced the improvements made by participants in the present study, although it would have been difficult to deliver in the context of the light-touch intervention.

A question remains about the nature of problematic use, and the likely characterisations of different presentations, including whether it is a primary problem or secondary to something else (e.g. anxiety or depression). Some authors have questioned this and suggested that formulation of an individual's presenting problem is important (Billieux et al., 2015), and others have highlighted the importance of identifying and managing triggers for use (Oulasvirta et al., 2012). Whilst these are likely to be beneficial, in the present study, they did not appear to be necessary in order for significant changes to be made. Some participants did reflect on the need to access additional support for other psychological difficulties, but this did not prevent them from engaging with and benefiting from the problematic smartphone use intervention, and for many the intervention contributed to other improvements.

5.4   Implications for intervening with problematic smartphone use

The present study provides evidence that a light-touch digital intervention for problematic smartphone use is acceptable. It is discussed above that three participants suggested alternative modes of delivery would improve the intervention; it may be that offering a choice in how the intervention is received would be advantageous. For example, recipients of the intervention could be given the choice of receiving the messages via the app or via email (meaning they could access it on a laptop), without any changes needing to be made to the intervention itself.

Although not all improvements met the criteria for reliable change, the majority of participants in the present study showed improvements in problematic smartphone use, dependency on the online world, mindfulness and wellbeing, and all participants described at least one positive change that they considered to have resulted from the intervention.

One participant reported the intervention progressed too quickly for her, and another stated that it was not delivered in her preferred order. These comments raise the possibility that there might be benefits to adding a flexibility and responsiveness to the intervention. If the intervention were to become more interactive, recipients could choose if and when they were ready to progress to the next suggestion/phase, and could select whether the suggestions were pitched at the right level for them, which would inform/dictate the subsequent suggestion.

All of the participants reported that they had tried only some of the suggestions, some of this was attributed to forgetting or not seeing the notification. Incorporating an additional alert system into the app, whereby participants are asked if they would like to be reminded later or if they have already tried the suggestion, may improve this.

One participant said that a longer-term intervention would be advantageous, whilst other participants spoke of continuing to use the ideas suggested to them. There have recently been developments where technology companies are building in the capability to deliver alerts or impose limits on usage (both smartphone companies and individual apps), and whilst the evidence suggests this is not sufficient for changes to be made, it certainly appears that it can contribute to reduced problematic use (perhaps through increased awareness). It has been argued that technology companies have a responsibility to ensure they are not encouraging problematic use (Ali et al., 2015), and this might be one way that longer term intervention can be offered, or early detection can be facilitated (through increased self-awareness).

Overall, the intervention package appears to be useful in reducing problematic smartphone use, however, the mechanisms by which change occurred could not be determined in the present study and further research is required (see 5.7). Clinically, there are currently no known intervention packages designed to intervene with problematic smartphone use. The guidance for intervening with internet addiction advises offering one-to-one CBT (Young, 2011), with evidence of effectiveness that may be translated in to problematic smartphone use. One-to-one CBT is, however, burdensome for both clinician and client. The present findings evidence the effectiveness of an intervention that can be automated and delivered remotely (eliminating clinician burden and reducing recipient burden), and that is acceptable as a first line treatment (an option for early intervention). The adaptations described above could be incorporated to improve engagement and recipient choice and control, which students previously indicated a preference for (Ali et al., 2015).

5.5 Strengths

The case series design of this study enabled a large amount of data (using multiple and frequent measurement) to be collected for each participant, and therefore for a thorough analysis of change (Elliott, 2002). The measures included a combination of both standardised self-report measures, and direct measurement; this meant that where possible the data was objective, and that the self-report measures were well validated.

The mixed-methods design adds weight to the validity of the conclusions; gathering qualitative data from participants during the change interviews to corroborate any conclusions drawn based upon the quantitative data. For qualitative data to be valid, participant honesty is important. The data was suggestive of honest accounts as participants reflected on unhelpful aspects of the intervention/study, and stated that they had not always tried the suggestions sent to them.

No participants chose to withdraw from the study, which is a strength. Attrition can be considered to bias results (Cuddeback, Wilson, Orme, & Combs-Orme, 2004), and so the low attrition rate reduces the chance of bias. Although one participant was withdrawn from the study and two from the analysis, this was owing to technical problems, which would indicate a less likely influence on results.

It is a strength that during the change interview participants were given the opportunity to reflect on events outside of the intervention that may have influenced change (see Elliott, 2002). Where any relevant outside events were identified, these were detailed in the results section, with the possible impact acknowledged. The case series design also provides a way of protecting against this, as not all participants experienced events that would have influenced change, and not all at the same time-points in their study participation (such as the impact of COVID-19).

5.6 Limitations

The study was designed with a two-week monitoring phase, with the intention of participants becoming habituated to the monitoring application. Several participants reported remaining aware of being monitored and this being influential throughout the study, it is possible that this influenced phone use, and their relationship with their phones. It is possible that the monitoring phase was not an accurate reflection of baseline phone usage, but also that all other phases were influenced by the knowledge of being monitored. Research aimed at reducing alcohol consumption in students has suggested that monitoring positively influences behaviour change, although there was additional benefit seen where students were

also offered intervention (Bewick et al., 2013). It was not possible to eliminate this possibility in the present study as the participants knew that their data was being actively monitored; a less personal approach (i.e. where participants were asked to install the app remotely without direct contact with the researcher) may somewhat control for this influence.

Another possible influential factor was the FitBit and the associated data; participants were required to install the app on their phone, on which they could access data about their activity and sleep. When participants were provided with the FitBit they were asked not to focus on this data, however, the temptation to do so can be understood, particularly as some participants were required to open the app to manually synchronise the data. Two participants reported that seeing the sleep data was beneficial; seeing how much sleep they were getting prompted them to adjust their behaviour to facilitate better sleep. These changes related to both smartphone use (i.e. not using phones before bed) and other behaviours (e.g. reducing alcohol intake).

For two participants a loss of smartphone data impacted the ability to interpret screen time duration during one phase. The lost data reduces the reliability of the medians calculated for those phases; although the overall group analysis considered only start and end comparisons, which were not impacted.

The lock/unlock data recorded by Phone Life Balance was deemed to be unreliable after the study had commenced; this meant that it could not be included in the analysis. As already discussed, there have been mixed findings regarding the relationship between screen time, frequency of usage, and severity of problematic use. The lack of reliable lock/unlock data meant that this relationship could not be explored in the present study.

As described in the method, an adaptation was made to the study protocol to send the intervention messages via WhatsApp for two participants (those with a particular brand of smartphone, as these did not reliably receive messages via Phone Life Balance). WhatsApp is a social media application, receiving the intervention messages via this platform may have increased the likelihood of users engaging with WhatsApp for other reasons.

The study was limited by being only available to Android users (as per the inclusion criteria outlined in Table 2). This has the potential to impact upon the generalisability of the findings, as Android and iPhone users may differ in the ways in which they use their phones, and the ways in which they are dependent upon them. Research has suggested that there are personality differences between iPhone and Android users (Heather et al., 2016), but there has not been an exploration of any relationship between operating system and problematic

use. It is not possible to know whether the same results would have been yielded in the present study had iPhone users been eligible and recruited.

The recruited sample lacked diversity overall; with nine of the ten participants being female, and all being white and of European origin, meaning that the generalisability of the results is uncertain. There is evidence to suggest that problematic smartphone use amongst males and females has different influences, and it has therefore been suggested that gender differences should be considered in the development of interventions (Aljomaa, Al.Qudah, Albursan, Bakhiet, & Abduljabbar, 2016; B. Chen et al., 2017; C. Chen et al., 2017; Kim & Shin, 2015). The exact nature of the gender difference varied across studies, and the differences highlighted would not appear to influence the potential utility of the intervention delivered in the present study for either gender.

Financial reimbursement was given to all participants in the present study; this may have influenced upon engagement/participation, although the extent to which cannot be determined.

5.7 Future research

The present study was able to determine that the intervention package was effective in improving problematic smartphone use, but not to determine the mechanisms through which change occurred. The findings suggest that problematic smartphone use is best measured via a self-report tool (such as the MPPUS), which in the present study was only administered pre and post intervention. Future research administering the MPPUS at more regular time points may facilitate a better understanding of the change process. This may enable the influences of the different intervention types to be explored and change mechanisms to be identified.

The lack of reliable lock/unlock smartphone data was identified above as a limitation; future research should include this data. This data would improve our understanding of the relationship between the different aspects of smartphone use and may also facilitate an understanding of the change process.

Longer term follow-up was not included in the present study design; follow-up could provide additional information about the ways change is maintained or continued, or the opposite. It would allow for consideration of whether those who did benefit maintained those improvements, and whether those who did not were able to make improvements following completion of the intervention, as was suggested in the change interviews.

The present study focused upon smartphone use, although we know that people often own and use multiple devices, sometimes simultaneously (Ofcom, 2019). One participant stated that she would at times switch from using her phone to her laptop. Whilst it was beyond the scope of the present research, exploring the use of all devices would have allowed for this aspect of usage to be explored. Further research exploring relationships between problematic use of smartphones and of technology or the online world overall would be important in ensuring an intervention such as this one does not result in the problem being transferred to another device. In the current study all participants reported a reduction in dependency on the online world, which suggests low risk of the problem being transferred to another device.

There was data collected in the present study that could not be analysed as it was beyond the scope of the study aims. However, opportunity for further exploration of this data is likely to add additional richness to the insights gained. This could include:

- analysis of sleep duration and patterns in relation to the other data;
- a more in-depth analysis of the smartphone data (including any changes in patterns of use over the course of the study, such as which apps participants were using and for how long, or the times at which they were using their phones and with what regularity);
- and an exploration of the additional feedback provided by participants (some participants provided comments on the daily surveys, relating to which strategies they had tried that day, or events outside of the study that may have influenced the data).

It would be important to know if there is a pattern in who is (and who is not) able to benefit from an intervention such as this one, and therefore to be able to determine suitability. A larger scale study would be required to be able to draw conclusions of this type.

Relationships between engagement and effectiveness of the intervention are important. The present study asked engagement questions only at the end of each phase; a more reliable measure would be to ask participants each day whether they had tried the suggestion (increasing the likelihood of accurate recall). This could also be used to increase engagement with the intervention; participants spoke of forgetting to try the suggestions on occasion, and stated that it would have been helpful to have additional reminders. A number of additional reminders could be sent, until the participant indicated that they had tried the suggestion. Options for improving engagement could be explored in future research, alongside evaluating the influence of engagement on effectiveness.

Adding in additional choice could also be explored, as previously mentioned, preferences could be indicated for mode of delivery (i.e. smartphone app, email), as well as timing of

delivery (as some participants described being less likely to engage if they received it early in the morning, or during their lectures). Two participants did express a preference for face-to-face contact. Whilst this would likely be quite a different intervention (given the present study explored a light-touch intervention), this is another consideration for future research, and could draw upon the findings presented here. A comparison of a digital and face-to-face intervention would increase our understanding of both preference and effectiveness.

A further consideration would be to explore peer influence; several participants spoke of noticing their friends using their phones and the impact upon connectedness as well as their own urges to use their phone. This may be influential in both understanding problematic use, and in intervening. Previous research has found that when participants are grouped with known-others (e.g. friends, family) the addition of social learning and competition increases the effectiveness of a smartphone monitoring app (Ko et al., 2015). This suggests that the intervention in the present study could be enhanced by a social element.

5.8   Conclusions

The intervention delivered in the present study has been shown to have a positive influence upon levels of problematic phone use. There is some evidence that the intervention also had a positive impact upon dependency on the online world, mindfulness, wellbeing, and sleep. The relationship between these changes and those made in problematic phone use remains unclear. The relationship between changes in problematic phone use and changes in screen time also remains unclear. Further research is required to add to our overall understanding and to further develop the intervention to incorporate some of the suggestions derived from the findings. Overall, the intervention is both acceptable and effective and should therefore be offered to students wishing to make changes to their problematic smartphone use.

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Appendix A: Confirmation of ethical approval

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School of Medicine Research Ethics Committee (SoMREC)

Sarah Kent
Psychologist in Clinical Training
Leeds Institute of Health Sciences
Faculty of Medicine and Health
University of Leeds
Level 10, Worsley Building, Clarendon Way
LEEDS LS2 9NL

23 July 2019

Dear Sarah

Ref no: MREC 18-088

Title: Brief Intervention for Problematic Smartphone Use in Undergraduate Students: A Systematic
          Case Series

Your research application has been reviewed by the School of Medicine Ethics Committee (SoMREC) and we can
confirm that ethics approval is granted based on the following documentation received from you and listed below.

Document	Version	Date Submitted
SK Ethics Submission V2	2.0	01/07/2019
Department Recruitment Email V1.0	1.0	01/07/2019
Email invitation to Case Series V2	2.0	01/07/2019
Ethics Appendix V2	2.0	01/07/2019
Flyer V2	2.0	01/07/2019
Participant Information Sheet V2	2.0	01/07/2019
Poster V2	2.0	01/07/2019
E-message V1	1.0	01/07/2019

Please notify the committee if you intend to make any amendments to the original research ethics application or
documentation. All changes must receive ethics approval prior to implementation. Please contact the Faculty
Research Ethics Administrator for further information (fmhuniethics@leeds.ac.uk)

Ethics approval does not infer you have the right of access to any member of staff or student or documents and the
premises of the University of Leeds. Nor does it imply any right of access to the premises of any other organisation,
including clinical areas. The committee takes no responsibility for you gaining access to staff, students and/or
premises prior to, during or following your research activities.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as
sample consent forms, any risk assessments and other documents relating to the study. This should be kept in your
study file, which should be readily available for audit purposes. You will be given a two week notice period if your
project is to be audited.

It is our policy to remind everyone that it is your responsibility to comply with Health and Safety, Data Protection and
any other legal and/or professional guidelines there may be.

We wish you every success with the project.

Yours sincerely

Dr Naomi Quinton, co-Chair, SoMREC, University of Leeds

(Approval granted by Dr Naomi Quinton on behalf of SoMREC Co-Chairs)

Appendix B: Participant Information Sheets (PIS) & Consent Forms (CF)

Appendix B.1: Recruitment survey PIS

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Understanding Your Smartphone Use

You are invited to take part in a research study. This study aims to see if feedback and support delivered via your smartphone could help you to manage your phone use. The first part of this study involves completing a survey. Not everybody who completes the survey will be invited to the next part of the study.

Everyone who completes the survey and provides their contact details will be entered into a prize draw, the prizes are 1 x £20 Amazon voucher and 1 x £10 Amazon voucher.

Further information about the study is provided on the next page.

You are being invited to take part in a research project.

Please take the time to read the following information carefully to help you decide whether or not you would like to participate in the study. It is important to understand why the research is being done and what it will involve.

What is the purpose of the study?

We are interested in whether feedback and support delivered via your smartphone will help you to manage your phone use. The following survey is to check whether you are eligible to take part.

Why have I been invited to take part?

All undergraduate students at the University of Leeds have been invited to complete this survey.

What will be involved if I agree to take part in this study?

This study involves two stages. During the first stage you are invited to complete this survey, which will ask you questions about your smartphone use and your wellbeing. It will take 20-30 minutes to complete the survey. We'll use this information to select and invite people to take part in the second stage of the study. Everyone who completes the first stage of the study and gives their email address will be entered in to a prize draw to win a either a £20 or £10 Amazon gift voucher. Whether you complete the second stage of the study will have no effect on your chances of winning the prize draw.

If you choose to complete the recruitment screening survey, and give your email address and agree to being contacted, you may be invited to complete the second stage of the study by email. In the second stage of the study you will be asked to use an app designed to help monitor your phone usage. You'll also be asked to complete surveys about how you are feeling and to attend an interview with the researcher at the University of Leeds. If you are invited to take part in the second stage of the study you will receive more information about what will be involved by email. Students who consent to being involved in the second stage of the study and who go on to complete the study will receive up to £30 for their participation.

Do I have to take part in the study?

Taking part in this study is voluntary, participants can withdraw at any time without giving a reason.

If you do decide to take part in the first stage of the study, but then change your mind, you can withdraw at any time by using the exit button on your internet browser. You do not have to give a reason for this.

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If you decide after completing the survey that you wish to withdraw your data, please contact the researcher within 14 days of completing the survey. Only data which has been submitted with an email address can be removed as all other submissions are anonymous. It is not possible to withdraw anonymous data from the study.

If you are invited to take part in the second part of the study you are under no obligation to do so, taking part in study two is also voluntary. You do not have to give a reason for not wanting to take part.

What will happen to the information obtained by the study?

Your answers on the questionnaires will be used to determine your eligibility for taking part in a research study. All of the data obtained will be treated as confidential and stored securely as is required by the Data Protection Act. The data collected at both the first and second stage of the study will be used as part of a Doctoral thesis and may be written up for publication. No identifying information about you will be included in the report.

If you are interested in the second stage of the study, we ask that you provide contact details so that we can get in touch if you are selected for the next stage. If you opt in to the prize draw, your contact details will also be used to enter you in to the prize draw. No other identifiable information is required.

All the contact information that we collect about you during the course of the research will be kept strictly confidential and will stored separately from the research data.

Only the research team will be able to see your data. Your data will be anonymised and saved on a secure electronic drive.

After this research has been completed, the data will be kept for use by the research team. All the data obtained will be treated as confidential and stored securely as is required by the Data Protection Act.

For further information about the University's use of personal data, please see: https://dataprotection.leeds.ac.uk/wp-content/uploads/sites/48/2019/02/Research-Privacy-Notice.pdf

What are the benefits and risks of taking part?

The study will help us to understand some of the things that might be (or might not be) helpful in improving students' relationships with their smartphones.

As a thank you for completing the survey, you will be entered in to a prize draw for £20 and £10 Amazon gift vouchers. Students who go on to complete the second stage of the study will receive up to £30 and may learn some potentially helpful new skills.

Who has reviewed this study?

This study has been reviewed by the School of Medicine Research Ethics Committee, University of Leeds [insert ethics approval number once granted].

How do I take part?

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You can take part in this study by completing the consent form on the next page, and then answering the survey questions.

If I have questions about the study, who can I ask?

If you would like further information please contact the Doctoral student who is completing this research, Sarah Kent (umske@leeds.ac.uk). You can also contact the Lead Supervisor, Dr Bridgette M Bewick (b.m.bewick@leeds.ac.uk).

Where can I access other support if I need it?

Although the study focuses specifically on smartphone use, we understand that some people participating might be experiencing distress. If you feel that you need further support or support for other difficulties you can find more information about how to access help on the *University of Leeds Support and Wellbeing page:* https://students.leeds.ac.uk/#Support-and-wellbeing.

Appendix B.2: Recruitment survey CF

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Consent Form

I confirm that I have read the participant information and understood what I am being asked to do in this research.

I understand that my responses to the survey will remain confidential.

I understand that my participation is voluntary, and I can withdraw at any time without giving a reason.

I understand that if I wish to withdraw my data from the study I must contact the researcher within 14 days of participation.

I give consent to take part in this research and for my anonymised data to be stored and used in the analysis of this research, and possible future research.

If you understand the information provided and consent to taking part in the study please confirm by clicking "next" below. You will then be redirected to the survey.

Appendix B.3: Case series PIS

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Understanding Your Smartphone Use (Part 2)

You have been invited to take part in a research study. This study aims to see if feedback and support delivered via your smartphone could help you to manage your phone use. There is a monetary reimbursement for your participation in this study (up to a maximum of £30).

The next part of the study will involve you:

- Completing online surveys
- Downloading an app on to your smartphone to monitor your phone use.
- Receiving messages to your phone which you will be invited to engage with and respond to
- Wearing a sleep and activity monitor
- Attending a short interview at the University of Leeds

Further information about the study is provided on the next page. Please read the information carefully. If you would like to continue after reading the information, please submit the consent form and confirm your contact details. If you consent to continuing with the study you will be contacted by the researcher.

What is the purpose of the study?

To see whether feedback and support delivered via your smartphone could help you to manage your phone use.

Why have I been asked to participate?

You recently completed an online survey. During that survey you expressed an interest in taking part in this part of the study.

What will happen to me if I take part?

If you agree to take part, you will be contacted by the researcher. Your participation in the study will last for up to 10 weeks.

At the beginning of the study, you will be asked to download a smartphone application (app). This app monitors your smartphone use (such as how many times you visit an app or how long you spend on it, it **does not** record the content of your messages/posts or your location).

You will be also given a watch with a built in activity and sleep tracker. You will be asked to wear it daily until the end of the study, and to allow the researcher to collect the data.

There will be different stages to the study. For example, sometimes you will be sent messages via the app. These messages might suggest things for you to try. Sometimes you will be asked to respond to the messages.

You will also be asked to complete online surveys.

At the end of the study you will be invited to attend an interview.

What will I have to do?

- Every day you will be asked to complete an online questionnaire. These questionnaires will be one of the following:

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- ○ A short online DAILY questionnaire which will take approximately 2 minutes to complete
- ○ A WEEKLY online questionnaire which will take approximately 5-10 minutes to complete
- ○ Beginning and end questionnaires that will take approximately 20mins to complete
- During one phase of the study you will be asked to do a short online activity.
- During the other three phases of the study you will be asked to read messages sent to your phone, and to respond to these.
- At the end of the study you will be invited to attend a brief interview.

Will the app use up my data?

No. The app does not use your data, the information collected by the app is only transferred when you are connected to Wi-Fi.

What will you do with my information?

Information collected via the app, Online Survey, and the sleep/activity tracker will be kept confidential. These data collection devices identify you via a unique code. The app will not hold any of your personal data, such as your phone number or email address. The app will **not** monitor your location or record the content of your messages or posts.

Only the research team will be able to see your information. Any saved information will be anonymised and saved on a secure University of Leeds electronic drive.

All the contact information that we collect about you during the course of the research will be kept strictly confidential and will stored separately from the research data

You are not asked to share any identifiable information via the app or on the online surveys. Any information you do share will be anonymised.

Once the study has been completed, the anonymised data will be kept securely for use by the research team. All the data obtained will be treated as confidential and stored securely as is required by the Data Protection Act. The data collected will be used as part of a thesis for a Doctorate and may be written up for publication. No identifying information about you will be included in the report. If any direct quotes are used within the report, these will be anonymised; any identifiable information will be removed and pseudonyms will be used.

If you share any information that suggests you might be a risk to yourself or others, the research team will have a duty to act on this. In these circumstances you may be contacted by the research team and confidentiality may need to be broken to access the right support for you.

For further information about the University's use of personal data, please see: https://dataprotection.leeds.ac.uk/wp-content/uploads/sites/48/2019/02/Research-Privacy-Notice.pdf

Will I be recorded, and how will the recorded media be used?

The interviews completed at the end of the study will be audio recorded and transcribed verbatim. The transcriptions will be used for analysis and will only be available to the research team. The transcripts and recordings will be stored on a secure University of Leeds electronic drive. The recordings will be deleted once analysis has taken place.

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What if I change my mind?

If you opt-in to the study, you can change your mind at any time without giving a reason. We ask that you inform the researcher if you no longer want to participate (via umske@leeds.ac.uk). You can choose to delete or turn off the app without having to give a reason. If you wish to withdraw identifiable data, we require that you inform us within 14 days of completion or withdrawal.

If you wish for the information you provide during the interview at the end of the study to be removed from the research, we require that you inform us within 14 days of the interview.

What are the benefits and risks of taking part?

The study will help us to understand some of the things that might be (or might not be) helpful in improving students' relationships with their phones.

If you complete the study, you will be reimbursed for your time. Participants will receive up to a maximum of £30. The more of the study you complete, the greater the reimbursement you will receive. Reimbursement will be given once your part in the study is complete.

If you withdraw from the study prior to completion and do not return the tracker, you will not be entitled to the cash reimbursement.

As part of the study you may learn some new skills, which will be of potential benefit to you.

Who has reviewed this study?

This study has been reviewed by the School of Medicine Research Ethics Committee, University of Leeds [insert ethics approval number once granted].

How do I take part?

You can take part in this study by confirming your consent and contact details on the next page, you will then be contacted with further details.

If I have questions about the study, who can I ask?

If you would like further information please contact the Doctoral student who is completing this research, Sarah Kent (umske@leeds.ac.uk). You can also contact the Lead Supervisor Dr Bridgette M Bewick (b.m.bewick@leeds.ac.uk).

Where can I access other support if I need it?

Although the study focuses specifically on smartphone use, we understand that some people participating might be experiencing distress. If you feel that you need further support or support for other difficulties you can find more information about how to access help on the **University of Leeds Support and Wellbeing page:** https://students.leeds.ac.uk/#Support-and-wellbeing.

Appendix B.4: Case series CF

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Consent Form

I confirm that I have read the participant information and understood what I am being asked to do in this research.

I understand that my information will remain confidential.

I understand that my participation is voluntary, and I can withdraw at any time without giving a reason.

I understand that if I wish to withdraw my data from the study, I must contact the researcher within 14 days of withdrawal or completion.

I give consent to take part in this research and for my anonymised data to be stored and used in the analysis of this research, and possible future research.

I give consent to anonymised quotes being used within reporting.

I give consent to being contacted by the researcher to arrange my participation in this research.

If you understand the information provided and consent to taking part in the study please confirm your consent and your contact details below. Following this, the researcher will be in touch via the details provided.

Appendix C: Outcome measures

Appendix C.1: MPPUS

Rate the following questions on a scale ranging from 1 ("not true at all") to 10 ("extremely true"):

1. I can never spend enough time on my mobile phone.
2. I have used my mobile phone to make myself feel better when I was feeling down.
3. I find myself occupied on my mobile phone when I should be doing other things, and it causes problems.
4. All my friends own a mobile phone.
5. I have tried to hide from others how much time I spend on my mobile phone.
6. I lose sleep due to the time I spend on my mobile phone.
7. I have received mobile phone bills I could not afford to pay.
8. When out of range for some time, I become preoccupied with the thought of missing a call.
9. Sometimes, when I am on the mobile phone and I am doing other things, I get carried away with the conversation and I don't pay attention to what I am doing.
10. The time I spend on the mobile phone has increased over the last 12 months.
11. I have used my mobile phone to talk to others when I was feeling isolated.
12. I have attempted to spend less time on my mobile phone but am unable to.
13. I find it difficult to switch off my mobile phone.
14. I feel anxious if I have not checked for messages and notifications or switched on my mobile phone for some time.
15. I have frequent dreams about the mobile phone.
16. My friends and family complain about my use of the mobile phone.
17. If I don't have a mobile phone, my friends would find it hard to get in touch with me.
18. My productivity has decreased as a direct result of the time I spend on the mobile phone.
19. I have aches and pains that are associated with my mobile phone use.
20. I find myself engaged on the mobile phone for longer periods of time than intended.
21. There are times when I would rather use the mobile phone than deal with other more pressing issues.
22. I am often late for appointments or meetings because I'm engaged on the mobile phone when I shouldn't be.
23. I become irritable if I have to switch off my mobile phone (or turn to aeroplane mode) for meetings, dinner engagements, or at the movies.
24. I have been told that I spend too much time on my mobile phone.
25. More than once I have been in trouble because my mobile phone has gone off during a meeting, lecture, or in a theatre.
26. My friends don't like it when my mobile phone is switched off.
27. I feel lost without my mobile phone.

Appendix C.2: Modified IAT

To begin, answer the following questions by using this scale:

0 – Does not apply
1 – Rarely
2 – Occasionally
3 – Frequently
4 – Often
5 - Always

1. How often do you find that you stay online longer than you intended?

2. How often do you neglect household chores to spend more time online?

3. How often do you prefer the excitement of being online to intimacy with your partner?

4. How often do you form new relationships with fellow online users?

5. How often do others in your life complain to you about the amount of time you spend online?

6. How often do your grades or academic studies suffer because of the amount of time you spend online?

7. How often do you check your e-mail or social media (e.g. Facebook, Whatsapp, Snapchat, Twitter) before something else that you need to do?

8. How often does your job performance or productivity suffer because of online activity?

9. How often do you become defensive or secretive when anyone asks you what you do online?

10. How often do you block out disturbing thoughts about your life with soothing thoughts of the online world?

11. How often do you find yourself anticipating when you will go online again?

12. How often do you fear that life without the online world would be boring, empty, and joyless?

13. How often do you snap, yell, or act annoyed if someone bothers you while you are online?

14. How often does your online activity interfere with your sleep?

15. How often do you feel preoccupied with the online world when offline, or fantasize about being online?

16. How often do you find yourself saying "Just a few more minutes" when online?

17. How often do you try to cut down the amount of time you spend online and fail?

18. How often do you try to hide how long you've been online?

19. How often do you choose to spend more time online over going out with others?

20. How often do you feel depressed, moody, or nervous when you are offline, which goes away once you are back online?

Appendix C.3: MAAS

Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.

> 1 - Almost always
> 2 - Very frequently
> 3 - Somewhat frequently
> 4 - Somewhat infrequently
> 5 - Very infrequently
> 6 - Almost never

1. I could be experiencing some emotion and not be conscious of it until some time later.
2. I break or spill things because of carelessness, not paying attention, or thinking of something else.
3. I find it difficult to stay focused on what's happening in the present.
4. I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.
5. I tend not to notice feelings of physical tension or discomfort until they really grab my attention.
6. I forget a person's name almost as soon as I've been told it for the first time.
7. It seems I am "running on automatic," without much awareness of what I'm doing.
8. I rush through activities without being really attentive to them.
9. I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.
10. I do jobs or tasks automatically, without being aware of what I'm doing.
11. I find myself listening to someone with one ear, doing something else at the same time.
12. I drive places on 'automatic pilot' and then wonder why I went there.
13. I find myself preoccupied with the future or the past.
14. I find myself doing things without paying attention.
15. I snack without being aware that I'm eating.

Appendix C.4: WEMWBS

Below are some statements about feelings and thoughts.

Please select the option that best describes your experience of each over the last 2 weeks:

1 - None of the time
2 - Rarely
3 - Some of the time
4 - Often
5 - All of the time

1. I've been feeling optimistic about the future
2. I've been feeling useful
3. I've been feeling relaxed
4. I've been feeling interested in other people
5. I've had energy to spare
6. I've been dealing with problems well
7. I've been thinking clearly
8. I've been feeling good about myself
9. I've been feeling close to other people
10. I've been feeling confident
11. I've been able to make up my own mind about things
12. I've been feeling loved
13. I've been interested in new things
14. I've been feeling cheerful

Appendix C.5: SWEMWBS

Below are some statements about feelings and thoughts.

Please select the option that best describes your experience of each over the last 2 weeks:

1 - None of the time
2 - Rarely
3 - Some of the time
4 - Often
5 - All of the time

1. I've been feeling optimistic about the future
2. I've been feeling useful
3. I've been feeling relaxed
4. I've been dealing with problems well
5. I've been thinking clearly
6. I've been feeling close to other people
7. I've been able to make up my own mind about things

Appendix C.6: CORE-OM

This form has 34 statements about how you have been OVER THE LAST WEEK. Please read each statement and think how often you felt that way last week. Then check the box which is closest to this.

| 0 – Not at all |
| 1 – Only occasionally |
| 2 - Sometimes |
| 3 - Often |
| 4 – Most of the time |

1. I have felt terribly alone and isolated.

2. I have felt tense, anxious or nervous.

3. I have felt I have someone to turn to for support when needed.

4. I have felt O.K. about myself.

5. I have felt totally lacking in energy and enthusiasm.

6. I have been physically violent to others.

7. I have felt able to cope when things go wrong.

8. I have been troubled by aches, pains or other physical problems.

9. I have thought of hurting myself.

10. Talking to people has felt too much for me.

11. Tension and anxiety have prevented me doing important things.

12. I have been happy with the things I have done.

13. I have been disturbed by unwanted thoughts and feelings.

14. I have felt like crying.

15. I have felt panic or terror.

16. I made plans to end my life.

17. I have felt overwhelmed by my problems.

18. I have difficulty getting to sleep or staying asleep.

19. I have felt warmth and affection for someone.

20. My problems have been impossible to put to one side.

21. I have been able to do most things I needed to.

22. I have threatened or intimidated another person.

23. I have felt despairing or hopeless.

24. I have thought it would be better if I were dead.

25. I have felt criticized by other people.

26. I have thought I have no friends.

27. I have felt unhappy.

28. Unwanted images or memories have been distressing me.

29. I have been irritable when with other people.

30. I have thought I am to blame for my problems and difficulties.

31. I have felt optimistic about my future.

32. I have achieved the things I wanted to.

33. I have felt humiliated or shamed by other people.

34. I have hurt myself physically or taken dangerous risks with my health.

Appendix C.7: BPNSS

Feelings I Have

Please read each of the following items carefully, thinking about how it relates to your life, and then indicate how true it is for you. Use the following scale to respond:

1	2	3	4	5	6	7
Not true at all			Somewhat true			Very true

1. I feel like I am free to decide for myself how to live my life.
2. I really like the people I interact with.
3. Often, I do not feel very competent.
4. I feel pressured in my life.
5. People I know tell me I am good at what I do.
6. I get along with people I come into contact with.
7. I pretty much keep to myself and don't have a lot of social contacts.
8. I generally feel free to express my ideas and opinions.
9. I consider the people I regularly interact with to be my friends.
10. I have been able to learn interesting new skills recently.
11. In my daily life, I frequently have to do what I am told.
12. People in my life care about me.
13. Most days I feel a sense of accomplishment from what I do.
14. People I interact with on a daily basis tend to take my feelings into consideration.
15. In my life I do not get much of a chance to show how capable I am.
16. There are not many people that I am close to.
17. I feel like I can pretty much be myself in my daily situations.
18. The people I interact with regularly do not seem to like me much.
19. I often do not feel very capable.
20. There is not much opportunity for me to decide for myself how to do things in my daily life.
21. People are generally pretty friendly towards me.

Appendix C.8: BIOLSCREEN

The following questions ask about your sleep over the PAST FOUR WEEKS.

1. In general, do you have problems with your sleep?   Yes ☐ No ☐
    a. If yes, how many nights a week do you have problems with your sleep? _____
    b. If yes, how long you had problems with your sleep?   _____
2. On average, how many hours sleep do you get each night? _____
3. Does the amount of sleep you get vary each night?   Yes ☐ No ☐
4. Does your sleep duration during the week differ from the weekend?   Yes ☐ No ☐
5. Do you have a regular time you go to sleep each night?   Yes ☐ No ☐
6. Do you have a regular time you wake up each day?   Yes ☐ No ☐
7. Have you had any of the following problems with your sleep?
    a. Difficulty getting to sleep   Yes ☐ No ☐
    b. Waking up in the middle of the night   Yes ☐ No ☐
    c. Waking up too early   Yes ☐ No ☐
    d. Feeling tired and unrested in the morning   Yes ☐ No ☐
8. Have you been told you snore?   Yes ☐ No ☐
9. Do you struggle to stay awake during the day?   Yes ☐ No ☐
10. Do you fall asleep during the day?   Yes ☐ No ☐
11. Do you use your bed for things other than sleep and sex (e.g., watching TV, using a computer or smartphone, eating)?   Yes ☐ No ☐

Appendix C.9: Adapted change interview

Reasons:

- Why were you interested in taking part in this study?

History:

- How did you feel about your smartphone use before the study?
- Have you ever tried to make changes to your smartphone use before? If so, was this successful?
- What sort of ideas or strategies have been helpful or unhelpful for you in the past?

Changes:

- What changes, if any, have you noticed in yourself since the study started? (For example, are you doing, feeling, or thinking differently from the way you did before? What specific ideas, if any, have you gotten from the study? Have any changes been brought to your attention by other people?)
- Has anything changed for the worse for you since the study started?
- Is there anything that you wanted to change that hasn't since therapy started?

Change Ratings (Go through each change and rate it on the following three scales):

- For each change, please rate how much you expected it vs. were surprised by it? (Use this rating scale:)

    (1) Very much expected it

    (2) Somewhat expected it

    (3) Neither expected nor surprised by the change

    (4) Somewhat surprised by it

    (5) Very much surprised by it

- For each change, please rate how likely you think it would have been if you hadn't been in the study? (Use this rating scale:)

    (1) Very unlikely without the study (clearly would not have happened)

    (2) Somewhat unlikely without the study (probably would not have happened)

    (3) Neither likely nor unlikely (no way of telling)

    (4) Somewhat likely without the study (probably would have happened)

    (5) Very likely without the study (clearly would have happened anyway)

- How important or significant to you personally do you consider this change to be (Use this rating scale)?

    (1) Not at all important

    (2) Slightly important

    (3) Moderately important

    (4) Very important

    (5) Extremely important

Attributions:

- In general, what do you think has caused these various changes? In other words, what do you think might have brought them about? (Including things both outside of the study and in the study)

Helpful Aspects:

- Can you sum up what has been helpful about the study? Please give examples. (For example, general aspects, specific events)

Problematic Aspects:

- What kinds of things about the study have been hindering, unhelpful, negative or disappointing for you? (For example, general aspects. specific events)
- Were there things in the study which were difficult but still OK or perhaps helpful? What were they?
- Has anything been missing? (What would make/have made the study more effective or helpful?)

Experience of the intervention:

- Would you recommend this type of intervention to others?
- Are you likely to continue using the ideas/skills? If so, which ones?

Suggestions:

- Do you have any suggestions for us, regarding the research? Do you have anything else that you want to tell me?

Appendix D: Stages of change questions

1. Has the amount of time you spend online changed in the past 12 months?

    ☐ No, I spend the same amount of time

    ☐ Yes, I spend ***less*** time

    ☐ Yes, I spend ***more*** time

2. Are you interested in spending less time online?

    ☐ Yes, I recently cut down the amount of time I spend

    ☐ Yes, I think about cutting down the time I spend

    ☐ Yes, I have tried and been unable to cut down the time I spend

    ☐ No, I am not interested in cutting down the time I spend

3. Do you think you spend more time online than you should?

    ☐ I am sure I spend more time online than I should

    ☐ I possibly spend more time online than I should

    ☐ I do not spend more time online than I should

Appendix E: Recruitment material

Appendix E.1: Recruitment poster

This research project is being conducted by Sarah Kent, as part of a doctoral thesis and has been reviewed by the School of Medicine Research Ethics Committee (MREC 18-088).

https://leeds.onlinesurveys.ac.uk/smartphones
https://leeds.onlinesurveys.ac.uk/smartphones
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https://leeds.onlinesurveys.ac.uk/smartphones
https://leeds.onlinesurveys.ac.uk/smartphones
https://leeds.onlinesurveys.ac.uk/smartphones
https://leeds.onlinesurveys.ac.uk/smartphones
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https://leeds.onlinesurveys.ac.uk/smartphones

Appendix E.2: Example recruitment email

Email Title:

Undergraduates – Do you want to know more about your smartphone use?

Email main:

Are you interested in understanding your smartphone use? Do you want to be in with a chance of winning an Amazon voucher?

You are invited to take part in a study about your smartphone use and wellbeing.

If you would like to find out more information and consider taking part in the study please visit: https://leeds.onlinesurveys.ac.uk/smartphones.

If you complete the survey you will be entered into a prize draw to win £20 and £10 Amazon vouchers. You could also be invited to the second part of the study, to earn up to £30 cash reimbursement.

If you have any questions and/or require further information about the study contact umske@leeds.ac.uk.
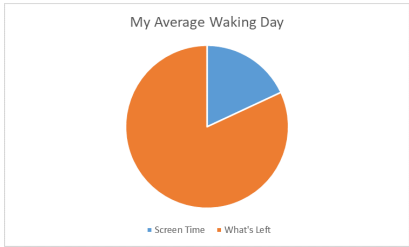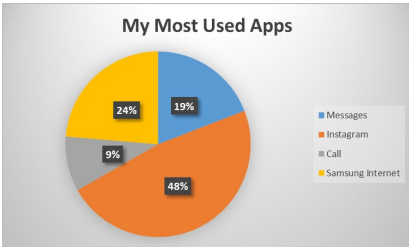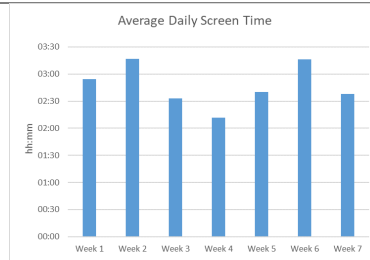
Kind regards,

Sarah Kent

Postgraduate Researcher

Appendix F: Example intervention messages

Appendix F.1: Personalised feedback

Title	Message
How much time do I spend on my phone?	Over the last month you spent almost 83 hours on your phone. Over a year, that is 42 whole days.
How often do I pick up my phone?	You unlock your phone up to 77 times each day.
How much of my day is taken up by my phone?	You use your phone for an average of 2h 50min each day. Click here [link to pie chart, as below] to see how much of your waking day that is.

My Average Waking Day

Screen Time ■ What's Left

Which apps do I use most?	Your 4 most used apps are: Instagram, Samsung Internet, Messages and Calls. These apps make up almost two thirds of your phone use. Click here [link to pie chart, as below] to see how they compare to each other.

My Most Used Apps

■ Messages
■ Instagram
■ Call
■ Samsung Internet

Which app do I spend most time on?	Instagram - over the last month you have spent around 23 hours on Instagram.
How much have I used my phone today?	Today (before 5pm) you have spent 1h 10mins on your phone, and unlocked it 25 times.
A summary of my phone use	Click here [link to graph, see below] to see a summary of your phone use time since the you started the study.

Appendix F.2: Behavioural suggestions

Title	Message
Reduce your notifications	Try turning off notifications for Instagram
Be less distracted during leisure time *(n.b. dependent upon client goal)*	You said that leisure time is important to you. Plan an activity, whilst doing this set your phone to "do not disturb" and place it out of sight, maybe in a different room (If others are with you, encourage them to do the same).
Have some phone free time before bed	Stop using your phone 30 minutes before you go to bed, do something else to wind down in this time.
Resist the urge to check your phone	Whenever you feel like you want to check your phone, delay it by 15 minutes, spend this time doing another activity.
Make your phone less important	Use something other than your phone as an alarm clock (your FitBit has an alarm function). If you need to make a note of something write it down instead of using your phone.
Have a phone break	Set yourself some phone free time (turn your phone off and place out of sight) - this might be a certain time window, or during a certain activity (e.g. mealtimes). A great idea would be to go out somewhere without your phone, if you can.
Stop notifications from distracting you	Turn all notifications to silent (this includes switching off vibrate). This way you get to choose when to check your phone.

Appendix F.3: Mindfulness exercises

Title	Message
A simple way to get present	Spend a few minutes focusing on the present moment. A simple way to do this is to use your senses. Pause for a moment and notice: 5 things you can see, 4 things you can feel, 3 things you can hear, 2 things you can smell, 1 thing you can taste
Be present during everyday activities	Pick an everyday activity (e.g. showering, washing the pots) and focus all of your attention on this activity while you do it. Your mind might wander but bring it back to the activity. You can use your senses like the activity yesterday.
Be present while you eat	Really focus your attention on something you eat today (this could be a meal or a snack). Try not to do anything else whilst you are eating. Again, use all of your senses.
Focus your attention when doing physical activity	Do a physical activity and focus your attention whilst you do it, this could be a walk or something more strenuous. You might notice things around you, or what is going on in your body, either or both would be okay.
Try a breathing exercise	This is a simple breathing exercise to help you connect with what is happening for you right now, wherever you are. When you are ready, click here [link to image, as below] for instructions. 1. Take ten slow, deep breaths. Focus on breathing out as slowly as possible until the lungs are completely empty, and then allow them to refill by themselves. 2. Notice the sensations of your lungs emptying. Notice them refilling. Notice your rib cage rising and falling. Notice the gentle rise and fall of your shoulders. 3. See if you can let your thoughts come and go as if they're just passing cars, driving past outside your house. 4. Expand your awareness: simultaneously notice your breathing and your body. Then look around the room and notice what you can see, hear, smell, touch, and feel.
Fully engage with an activity you enjoy	Pick an activity that you really enjoy (this might be listening to your favourite music, or doing something creative) and be sure to engage with it fully and give it all of your attention. If your mind wanders, notice this and bring it back to the activity.
A way to let your thoughts go	This exercise helps us to notice our thoughts and then let them go. This video link [URL to "leaves on a stream" mindfulness exercise: https://www.youtube.com/watch?v=r1C8hwj5LXw] will guide you through the exercise (3.5mins long).