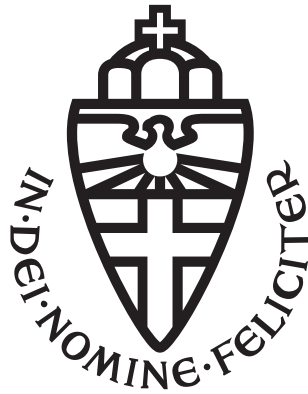# Bachelor's Thesis Computing Science

Radboud University Nijmegen

Investigating the Impact of Gamification on the Quality of Digital Mindfulness Practices

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Abstract

Gamification is increasingly prominent in an increasingly wider range of systems, including mindfulness applications, while no real scientific background is present to know what the effects of these gameful elements are on these systems. In many systems, the motivating factor of gamification might be enough to justify its usage, this doesn't necessarily hold for mindfulness. In previous literature, it was pointed out that gamification might be detrimental to the quality of the mindfulness practice itself, and hence should be used carefully in mindfulness applications. Since mindfulness has been pointed to as an important part of the solution of the current mental health problems, especially amongst young adults, this thesis set out to explore the effects of gamification on the quality of mindfulness. An initial questionnaire was set out to explore the usage patterns of mindfulness applications of young adults ($n = 31$). The use of gameful elements was analysed in the most-used applications. Subsequently, an exploration of what constitutes a high-quality mindfulness practice was performed using a non-systematic literature review. Using the same method, we explored what possible risks and benefits of gamification in mindfulness applications could be. In a second questionnaire ($n = 53$) we examined how users experience gamification in the light of these findings. It was found that both benefits and risks associated with using gamification in mindfulness applications exist. We suggest that these findings are taken into consideration when designing (new) mindfulness applications.

Contents

Chapter 1

Introduction

Amongst university students, depression, anxiety, and other mental health disorders are very common. Since the start of the Covid-19 pandemic, specifically loneliness and sadness have increased even more amongst Dutch persons aged 18-25 [1]. Fortunately, there is a growing body of research into possible solutions, among which research to the effect of mindfulness-based interventions [2].

Mindfulness—often defined as "non-judgmental awareness of the present moment" [3]—found its way into the world of mental health and therapy mainly via the intervention method MBSR - Mindfulness-Based Stress Reduction. This method was developed to bridge the gap between the Buddhist traditions surrounding mindfulness and the secular therapy [2]. It asks participants to engage in a rather intensive 8-10 week programme, in which group sessions, all-day sessions and individual at-home practice alternate[4], and is shown to be effective in treating stress and anxiety [5].

With the digitalisation of almost everything, the question naturally arose how mindfulness could be digitalised as well [6]. Could we digitalise mindfulness and keep the benefits of in-person mindfulness practices? Thus, research emerged to the effect of mindfulness applications, e.g., [7]. The mindfulness app Headspace[1], for example, was found to have a positive effect on the depression scores of college students. It seems that the positive effects found in in-person mindfulness interventions can (at least partially) be found in digital mindfulness interventions. This combined with the accessibility of mindfulness applications gives good hope.

However, concerns have been raised that the digital mindfulness practice bears lesser quality than traditional in-person mindfulness practices [3]. It is argued that the mindfulness applications are indeed a useful tool for relaxation, but that one maybe cannot really call them mindfulness practice providers. One of the main points of criticism is the use of gameful elements like streaks and badges in these mindfulness applications. This

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[1]https://www.headspace.com

so-called gamification would be antithetical to mindfulness, distracting the individual from the current moment. [3] Proponents of gamification, however, point mainly to the increased engagement in the application because of gameful elements, e.g., [8].

There has been some research into this question, whether gamification would be detrimental or beneficial to the mindfulness practice. However, this research mainly investigates whether the addition of gamification affects the effectiveness of the mindfulness intervention, instead of investigating the effect of gamification on the quality of the mindfulness, e.g., [9].

It seems that when comparing the quantity of a mindfulness practice to the quality of this practice, quality is the predictive factor in psychological well-being over time [10]. It is therefore relevant to find out whether gamification of the practice influences the quality. If the quality turns out to be decreased due to gamification, it will decrease the positive effects on the well-being of users (compared to the practice having equal quantity).

With that, we come to this thesis. In this thesis, we ask ourselves the following question:

> **How does the gamification of the digital mindfulness practice influence the quality of this practice?**

I will explore this question by answering the following subquestions:

1. How is mindfulness being digitalised, and how is gamification present in digital mindfulness applications?

2. What are the important aspects of a high-quality mindfulness practice?

3. How could gamification be beneficial to the mindfulness practice and how could it be disadvantageous?

4. How is the gamification of the digital mindfulness practice experienced by users?

The goal is not to present complete statistically significant sound results. Rather, this thesis is meant to an initial picture of the above research questions, and explore trends in the relation between gamification and mindfulness among young adults.

This thesis is structured as follows. In the next chapter, Theoretical Framework, I will explore the current literature, sketching the theoretical framework in which this thesis falls. In chapter 3, Research, the methods used to answer the above research questions will be discussed. The results of the application of these methods can be found in chapter 4, Results. These results, as well as the limitations of this thesis and pointers to possible future work will be discussed in chapter 5, Discussion. Final words can be found in chapter 5, Conclusions.

Chapter 2

Theoretical Framework

2.1 Mindfulness

Mindfulness can simply be defined as "non-judgemental awareness of the present moment"[3]. It often covers sitting and moving meditation, breath work, and visualisation exercises [11]. However, as [12] points out, mindfulness is defined differently in many research articles. Apart from the definition just mentioned, mindfulness is also defined slightly more exhaustive as "the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment"[2], somewhat critically as "an umbrella term used to characterize a large number of practices, processes, and characteristics, largely defined in relation to the capacities of attention, awareness, memory/retention, and acceptance/discernment"[13], and many more. This ambiguity also makes it non-trivial to provide an exact list of aspects that make a high-quality mindfulness practice. This will be explored more in Aspects of a high-quality mindfulness practice.

2.2 Gamification

Gamification is regularly described as "the use of game design elements in non-game contexts"[14]. Alternatively, one can define gamification as "a process of enhancing a service with affordances for gameful experiences in order to support [a] user's overall value creation" [15]. [16] argues that the first definition is very useful when researching gamification, while the second definition could be more useful when one wants to implement gamification. They elaborate: "[the second definition] implies that for gamification to occur, a gameful experience must be had". In this thesis, I follow the first definition when analysing the mindfulness applications

In 2019, a review article was published in which gamification in mental health and well-being applications was analysed [17]. Even though the apps

they analysed only included 1 self-proclaimed mindfulness app, the other 49 apps are within the closely related realm of mental health. The results of this analysis are an interesting starting point for the sub-question on how gamification is implemented in mindfulness applications. The resulting taxonomy of gamification elements covers the following elements: (1) levels or progress feedback, (2) points or scoring, (3) rewards or prizes, (4) narrative or theme, (5) personalisation, (6) customisation, (7) social networking, (8) includes mini-game, (9) quests or challenges, (10) badges or achievements, (11) social competition, (12) social comparison, (13) randomness, (14) artificial challenge, (15) exploratory or open-world approach, (16) social cooperation, (17) unlockable content, and (18) artificial assistance. I will use this taxonomy to analyse how gamification is applied in mindfulness applications, as described in Taxonomy gamification in mindfulness applications

To take a step back, let's focus on why gamification is implemented in the first place. In general, the goal of gamification can be seen as to improve engagement of users. The idea is that improved engagement both improves the user experience, by improving interest to the task provided by the application, and increases monetary value for the creator(s) [18]. More specific to the field of mental health, [17] found two main themes researchers gave for applying gamification: (1) "Promote engagement with an intervention", and (2) "Enhance an intervention's intended effects". This will be explored further in Possible risks and benefits of gamification.

2.3   Related work

2.3.1   Digital mindfulness applications

In an analysis of 16 often-used mindfulness applications, [11] found that the majority of the mindfulness relies on external input, such as a voice-guided meditation. Only a few put their focus on internal processes, just providing the sound of a bell indicating the start and end of a meditation session. Except for Headspace—which provides educational infographics and videos—none of the analysed mindfulness applications actually provide explanations about what mindfulness is and entails. Additionally, among the 16 analysed applications, Headspace was found to be the only one explicitly evidence-based. [11]

In a short analysis, [6] finds four levels of digital mindfulness. The first level is what they call 'Digitalised mindfulness'. This level covers applications that merely replace mindfulness teachers with pre-set texts, audio files and/or videos. Level 2 is called 'Personalised mindfulness', in which content is personalised based on characteristics of the user. Most applications described above fall in this category. This level is followed by 'Quantified mindfulness', where technologies like wearable sensors provide feedback on

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the performance and capability of the user, which is used to further personalise the practice. As the authors explain, these first three levels are appropriate when the goal is to be more mindful during and right after a meditation session. Missing in these methods is the focus on and guidance towards the broader mindfully living in every moment, which would be the fourth level. This separation will be explored more as formal and informal mindfulness practice in Aspects of a high-quality mindfulness practice.

2.3.2 Mental health effects of digital mindfulness

There have been multiple research projects that investigated the effects of mindfulness applications on the mental health and/or well-being of users. For example, [19] explored this effect in university students. They instructed students to either use one of two Mindfulness applications (Headspace or Smiling Mind[1]) or to use a control app, Evernote[2]. Each student was instructed to use their assigned app 10 minutes a day for 10 days, after which they were free to use (or not use) the app for another 30 days at their own discretion. Their mental health, measured by markers such as depressive symptoms, anxiety, stress, and mindfulness, was assessed before trial, after the first 10 days, and after the final 30 days. Significant, but small improvements of the mental health of the students who used the mindfulness apps were found after 10 days, most notably on depressive symptoms. Additionally, a higher frequency of use in the free usage 30-day period could be linked to the greatest improvements. Similar results were found in [20], [7] and [21].

2.3.3 Gamification of digital mindfulness

There is a very limited body of research focusing on the effect of gamification on the mindfulness practice. In 2016, an article was published that explored this effect. [8] More specifically, they investigated the effects that reward systems had on the distress levels of users. They did so by designing a gamified and a non-gamified version of Smiling Mind. The gamified elements included four reward types: (1) access to previously inaccessible environments, (2) badges for completing sessions and streaks, (3) praise upon receiving badges, and option to share achievement, and (4) visual feedback on how close the user is to the next badge (progress bar). No significant differences were found between groups using a completely non-gamified, completely gamified or delayed-access-gamified versions. All groups experienced a small positive change in their distress levels. A possible explanation for this absent difference is the fact that the participants used Smiling Mind very little, not producing enough data to find statistically significant differences between

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[1] https://www.smilingmind.com.au/
[2] https://evernote.com/intl/

groups. The article suggests that the low adherence may be due to the programme using a website, instead of a mobile application, or due to the participants being paid to participate.

A more recent study [9] performed an extensive meta analysis on 5597 research articles that all analysed the effect of mental health apps on depressive symptoms, ranging from interventions based on Cognitive Behavioural Therapy and Acceptance and Commitment Therapy to mindfulness apps. These included both apps using gamification elements and apps not using gamification elements. The aim of the meta analysis was to find out whether the addition of gamification elements has a different effect on the depressive symptoms of users compared to non-gamified applications. There was no difference found; both gamified and non-gamified applications showed the same positive effect on depressive symptoms. Although this suggests that gamification of the mindfulness practice has no effect on the well-being of the users, one cannot conclude anything about the quality of the practice itself based on this study, which is what will be explored in this thesis.

2.3.4 Designing gamification of digital mindfulness

Although there has been a limited focus on the actual effects of gamification of the mindfulness practice, concerns about it have been raised regularly in related research. In a 2016 article on the effects of a (non-gamified) digital mindfulness practice on distancing from negative thoughts [22], gamification and monitoring aspects are discussed. They fear that having these elements would instil a striving mindset in users, which could stand in the way of the mindfulness itself. These concerns were also raised by mindfulness teachers when being interviewed about their perspectives on digital mindfulness practices [3]. Many were concerned that gamification is inherently conflicting with mindfulness, since mindfulness is about accepting the current moment without judgement. However, some also saw a practical benefit in getting new students started with building a practice, as gamification aims to improve engagement. Additionally, the teachers were worried about the effect of being able to compare one's practice with the practice of others. As one of the teachers expressed: "When the mind compares, it can't be present. It can't." Connected to this, concerns were raised about the possibly distracting nature of gamification elements in mindfulness applications, making it harder to focus on one's own mind [3]. This will be explored more in Possible risks and benefits of gamification.

In the same article, an important tension is raised: the issue that many apps, including many mindfulness apps, are designed for commercial purposes, while mindfulness in essence is not supposed to be commercialised and monetised. This relates to the issue of designing for disengagement from digital tools, which many mindfulness teachers see as a necessary step when an individual progresses in their practice [3]. Gamification is generally

implemented to improve engagement of users and thus to, simply put, make more money. Although this tension is an interesting aspect of the research question, I will not directly focus on it.

Chapter 3

Research

3.1 Target population

Previous research has shown that although there is no significant difference in initial perceived effect of gamification between individuals from different age groups, there is a difference in how long individuals from different age groups perceive effectiveness of the gamification. Younger people tend to 'get bored' more easily and faster than older users, perceiving less effectiveness quicker [23]. Unfortunately, reliable figures about the distribution of users' ages of popular mindfulness application such as Headspace and Calm[1] are not available. Thus, this data still had to be collected, see Usage of mindfulness applications.

Previous works on the effects of digital mindfulness applications have focused on university and/or college students because of the worse mental health amongst this group compared to the average [7]. Others have worked with the same group as a convenience sample [19]. Since there is the most solid research basis for the positive effects of digital mindfulness on the well-being of young adults (aged 18-25), I will also focus on this age group in this thesis.

I will not limit the target group to a certain ethnicity. Previous work on the effects of a digital mindfulness practice on the psychological well-being of university students found no difference in the interpretation of the results between models in which they did control for a number of characteristics, including ethnicity, and models in which they did not [21]. Additionally, research on the perceived effect of leaderboards as gamification found no differences based on ethnicity [24].

Concluding, the target group of this thesis is young adults aged 18 to 25 (inclusive), who have used any mindfulness application at least once, without any other limitations.

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[1] https://www.calm.com/

3.2 Methodologies

In this section, I will discuss the methodologies used to answer each sub-question.

3.2.1 Usage of mindfulness applications

In order to know which applications should be analysed on their use of gamification elements, data on which applications are mostly used by the target population is needed. This data is currently not available. Therefore, a short initial questionnaire was designed and sent out. This questionnaire asked participants which mindfulness applications they used in the past and are still using at the time of the questionnaire. Additionally, an initial inquiry to motivation was performed by asking why they started using mindfulness applications and why they continued. The questionnaire as sent out can be found in Appendix A: Questionnaire 1.

The mindfulness applications presented were based on the most popular mindfulness applications as found by [11]. Included in the questionnaire were the applications from their list that were available in the Google Play Store at the time of making the questionnaire (February 3rd, 2022), plus Smiling Mind, which was evaluated by [25] and available in the Google Play Store. I included the requirement of availability in the Google Play Store, because I personally have an Android phone, and no guaranteed access to an iPhone (or phones with alternative operating systems and app stores). The possible reasons for starting and continuing using mindfulness applications, as presented in the third and fourth question, were based roughly on reasons for practising mindfulness as found by [26]

3.2.2 Taxonomy gamification in mindfulness applications

Using the results of the first questionnaire, the reported most-used mindfulness applications were analysed using the taxonomy defined in [17] as shortly introduced in Gamification. This taxonomy was used because it was fine-tuned for applications within the closely related field of mental health.

3.2.3 Aspects of a high-quality mindfulness practice

There is no usable answer of what constitutes a high-quality mindfulness practice. Part of the problem is that there is no consensus on the definition of mindfulness itself. Therefore, I first explore the concept of mindfulness further. Then, I explore existing methods to measure practice quality. Subsequently, I formulate aspects that are apparently important for a high-quality mindfulness practice.

In [27], a literature review is performed on 38 papers on mindfulness in HCI, after which a framework for mindfulness in HCI is created. This

framework will be used as a basis for the non-systematic literature review performed to answer the question of what the important aspects are of a high-quality mindfulness practice.

3.2.4 Possible risks and benefits of gamification

In the current literature, there is relatively much to be found on the effects of gamification on health-outcomes. There is a lot less research available on the effects of gamification on *mental* health-outcomes, and practically nothing on the effects of gamification on the quality of mindfulness, with the notable exception of [3]. Even if studies analyse the addition of gamification to mindfulness applications, they see the apps as a method to improve one's mental health, and thus test the effects of the application by testing the mental health of the user. Hence, there is no clear-cut answer to the question of how gamification could affect the quality of one's state and/or trait mindfulness. I will try to answer this question by a non-systematic literature review, where I started off with the search term 'mindfulness gamification'.

3.2.5 Experiences of gamification in mindfulness applications

In order to find out what the effect of gamification is on the quality of mindfulness, and especially how this is perceived by users, a second questionnaire was set out. The questionnaire targeted both current users and previous users of mindfulness applications, as long as they are within the age of 18 to 25.

The majority of the questionnaire targets both current and past users. All are asked why they initially started using mindfulness applications and how often they used/are still using it. Then, those who did not continue are asked how long ago they started and stopped using mindfulness applications, and why they didn't continue. Additionally, they are asked which application they used, and why they chose that one in particular.

Current users are also asked when they started using mindfulness applications. Then, they are asked why they continued using mindfulness applications, which they use, and why they use that one in particular.

All other questions are asked to all respondents.

Personal characteristics Based on the results found in Possible risks and benefits of gamification, questions were included to discover certain characteristics from the participant: whether they are more introvert or more extravert, how sensitive to rewards they are, and how 'emotionally stable', or not neurotic they are. As pointed out in Possible risks and benefits of gamification, neuroticism, when mapped on the high-quality aspects of mindfulness, is exactly the opposite of having a high quality trait mindfulness. Therefore, no extra questions were included to measure neuroticism,

other than those targeting trait mindfulness, as described below.

Trait mindfulness   To be able to say something about the relation between gamification and the quality of mindfulness, we need to measure this quality of mindfulness of participants. As discussed in Aspects of a high-quality mindfulness practice, there are a number of methods developed to measure either or both state and trait mindfulness. FFMQ (Five-Facet Mindfulness Questionnaire) combined multiple questionnaires targeting trait mindfulness, which resulted in a recognised questionnaire covering the five facets that I took as well as being important to a high quality trait mindfulness.

I will use the FFMQ to measure the trait mindfulness of participants. However, the FFMQ is rather long, so in order to not discourage participants from filling in the entire questionnaire because of its length (and the last section already was rather long), I decided against including all 39 questions from the FFMQ. Instead, I included 10 questions; 2 from each facet. I chose these 2 from each facet to be as diverse as possible, as to cover each facet as much as possible. The questions I included are:

- Observing: FFMQ 11 and FFMQ 15

- Describing: FFMQ 7 and FFMQ 22

- Acting with awareness: FFMQ 5 and FFMQ 23

- Nonjudging: FFMQ 10 and FFMQ 35

- Nonreacting: FFMQ 21 and FFMQ 24

State mindfulness   State mindfulness is a snapshot, often measured right after a meditation session or other formal practice session. Since participants can fill in the questionnaire at any time, it makes no sense to measure their state mindfulness. Their average state mindfulness, however, will be implicitly covered by the questions on their perception of gameful elements. For example, the question "During a meditation session, I think of my streak" asks the participants to reflect on how often they are distracted by their streak during a formal practice, hence whether their state mindfulness is affected by the gameful element.

Experienced and perceived gamification   The last section of the questionnaire aims to find out how the participant experiences gameful elements. Here, questions were formulated per possible benefit and risk as found in Possible risks and benefits of gamification.

The complete questionnaire, as sent out to participants, can be found in Appendix C. The questionnaire was sent to the participants of questionnaire 1 who left their email address, and was shared on multiple social media platforms.

Chapter 4

Results

4.1 Questionnaire 1

On the initial survey, 34 responses were received. Three of these responses answered 'no' to the question '*Have you read and understood the above information, do you agree to participate, are you at least 18 years old and at most 25 years old and have you used a mindfulness application at least once?*'. These three responses were discarded. The remaining 31 were used. One notable point was found when examining the data on its quality; some people who filled in they 'used it regularly in the past' filled in reasons they continued using the mindfulness application(s), while others answered 'I did not continue using the mindfulness applications' to the question '*What is the main reason you continue(d) using the mindfulness application(s)?*'. This discrepancy does not really matter in analysing this questionnaire, since the questions on motivation were purely as initial orientation on the motivations of people to use mindfulness applications. However, for the second questionnaire, this discrepancy should be avoided by formulating the questions differently.

Mindfulness applications   The main purpose of this questionnaire was to find out which applications were used most by the target population. There is one application that very clearly gets used the most, which is Headspace ($n=26$), followed by Calm ($n=10$) and Insight Timer ($n=6$)[1]. Other than these, there are only two applications that get used by more than one respondent: Tide ($n=3$) and VGZ Mindfulness Coach ($n=2$).[2] For a visual overview of the used applications, see Figure 4.1. Only applications that were mentioned at least once are included.

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[1] From now on, I will shorten the names of the mindfulness applications for readability, i.e., 'Headspace' for 'Headspace: Mindful Meditation', 'Calm' for 'Calm - Meditate, Sleep, etc. Complete, official names can be found in Appendix A Questionnaire 1

[2] Two respondents answered 'VGZ Mindfulness App'. No app with that name exist, so assumed is that 'VGZ Mindfulness Coach' was meant
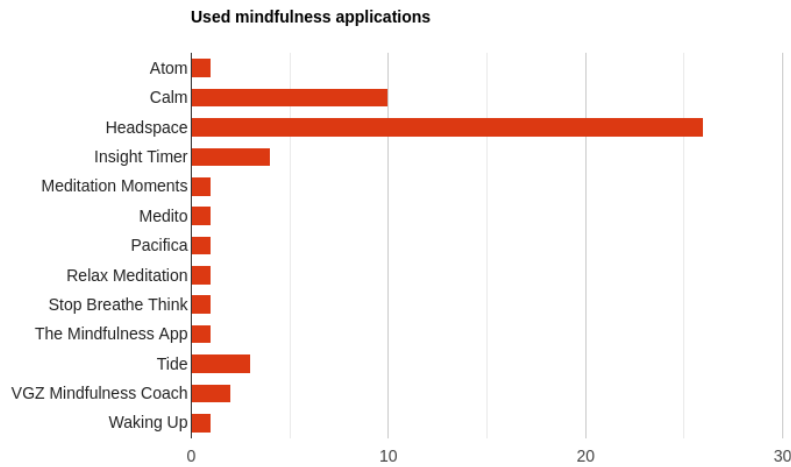
Used mindfulness applications

Figure 4.1: Used mindfulness applications by respondents (questionnaire 1)

Frequency of use A slight majority of respondents used mindfulness applications in the past (either only a few times, or regularly), while the rest still uses it at least sometimes. From the available data, we can't draw any conclusions on whether usage of certain applications correlates with the frequency of use. A visual representation of the usage frequencies can be found in Figure 4.2

Motivation The most important reasons for trying out mindfulness applications seem to be '*to relax/reduce stress*'(n=18), '*to improve mental health*'(n=13) and', '*curiosity*'(n=12). The most important reasons for continuing to use mindfulness applications are less clear. '*To improve mental health*' and '*to relax/reduce stress*'(n=8) are still on top, now followed by '*to live more mindfully*'(n=6) and '*to improve sleep*'(n=5). An interesting point to note in the light of the main purpose of this thesis is that those still using mindfulness applications multiple times a week or daily list '*to live more mindfully*' as one of their top motivations(n=3). In Figure 4.3, the answers to both questions about motivation (start and continue reasons) are combined.
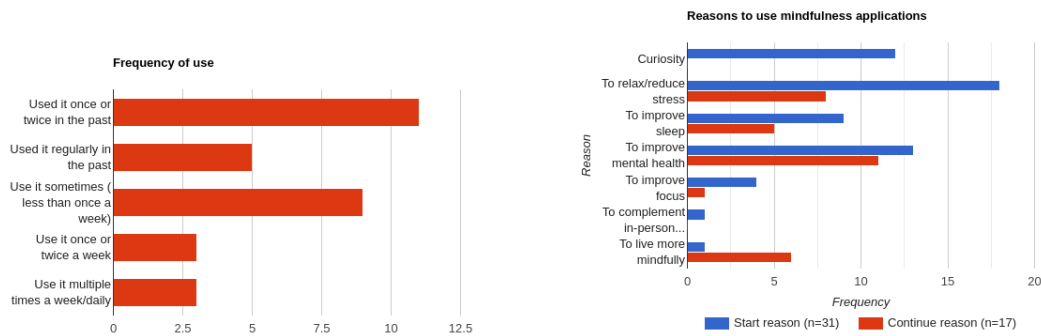
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Figure 4.2: Usage frequencies of respondents (questionnaire 1)

Figure 4.3: Reasons participants started and continued using mindfulness applications (questionnaire 1)

4.2 Analysis of most-used applications

As said above, the results of the questionnaire indicated there was not a great diversity in the mindfulness applications used by the respondents. In total, the respondents use(d) 13 different mindfulness applications. I decided to analyse the applications that were used by at least 2 respondents; (1) Headspace, (2) Calm (3) Insight Timer, (4) Tide and (5) VGZ Mindfulness Coach. In Table 4.1, the results of applying the aforementioned taxonomy can be found. The explanation of the gamification elements found in these mindfulness applications, taken directly from the taxonomy as defined by [17], and a short explanation of each of the found elements can be found in Appendix B Taxonomy Gamification. Headspace and Insight Timer were found to have the most gamification elements, 6 and 5 respectively. Calm and Tide were found to present 3 gamification elements, while no gamification was found in VGZ Mindfulness Coach.

	Artificial assistance	Artificial challenge	Badges or achievements	Customisation	Exploratory or open-world approach	Includes mini-game	Levels or progress feedback	Narrative or theme	Personalisation	Points or scoring	Quests or challenges	Randomness	Rewards or prizes	Social comparison	Social cooperation	Social networking	Unlockable content
Calm (3)				✓			✓		✓								
Headspace(6)			✓	✓			✓		✓					✓		✓	
Insight Timer(5)			✓	✓			✓		✓							✓	
Tide(3)				✓			✓		✓								
VGZ(0)																	

Table 4.1: Gamification elements found per table

4.3 Aspects of a high-quality mindfulness practice

What do we mean by mindfulness?

To those unfamiliar with the concept of mindfulness, I have noticed that the following proposed definitions reap the most understanding: mindfulness as the opposite of mind-wandering[28] or as the opposite of mindlessness[29]. However, these definitions are not very specific. Within the very limited number of articles on mindfulness in the context of Buddhism, there is also a lack of specific definitions. Instead, it is often deliberately left vague.[27] Within the context of therapeutical practices, the most-used definitions is the one offered by the creator of Mindfulness-Based Stress Reduction (MBSR), Jon Kabat-Zinn: "[Mindfulness is] the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment"[2]. Critics have said this definition is non-exhaustive. However, within the context of therapy, it has been used to develop MBSR and many more Mindfulness-Based Interventions (MBIs).[27] In psychology, more diverse definitions are used. According to [27], the following three conceptualisations are the most used in HCI research: (1) [30] defined mindfulness as "a cognitive process of noticing new things". They also used the simple definition of mindfulness being the opposite of mindlessness. (2) In [31], a two-component model is proposed: (a) self-regulating attention, and (b) orientating to experiences.

(3) [32] offers two perspectives on mindfulness: (a) a state or mode a person rises to, and (b) a trait everyone bears. The state mindfulness then refers to the mindfulness of an individual at a particular moment, often during a meditation practice. The trait mindfulness refers to the long-term mindful capacity an individual bears.

Apart from trying to find a single definition of mindfulness, we can also take a look at the aspects that are shared by most, if not all, proposed definitions. This was also the reasoning of [27]. In order of most frequently mentioned in the articles covered in their review analysis, these are the aspects found: (1) attention, (2) presence, (3) experience, (4) non-judgmental, (5) moment-to-moment, (6) awareness, (7) acceptance, (8) reflection, and (9) intention.

To be able to differentiate between short-term improved mindfulness, and the long-term *way of being*, I choose to use the conceptualisation of mindfulness [31] proposes. This means I will use the two perspectives of the state mindfulness and the trait mindfulness to look at mindfulness. By discussing other possible conceptualisations of mindfulness, I acknowledge that this definition is not the absolute truth, and just a tool to analyse mindfulness. Where relevant, I will refer to other conceptualisations, as well as the above discussed aspects.

What do we mean by the mindfulness practice?

Broadly speaking, mindfulness practice can be divided into two categories: formal and informal practice. Formal practice takes place when an individual consciously makes the decision to take part in some form of mindfulness meditation. Informal practice, on the other hand, covers the way an individual is mindful in their daily activities, e.g., bringing conscious awareness to the activity of eating. When looking at the definition [32] presented, as shortly introduced above, we can relate formal practice to improving mindful state, while informal practices can help improve one's trait mindfulness.

Let's place this in the context of mindfulness applications. The—often guided—meditation sessions offered by the applications are formal practices. The user consciously decides to press play and take some time to meditate. Some applications also aim to improve the mindful condition throughout the day, i.e., improve the trait mindfulness of the user. For example, Headspace gives the option to get notifications during the day to be reminded to be mindful in your everyday activities. The notifications contain messages such as "No matter how fast life is moving around us, there is always a place of stillness inside."

How do we measure practice quality?

Several measures of mindfulness practice quality exist. Part of these focuses on evaluating formal practices, part focuses on the state mindfulness, thus the informal practice. Most were designed to evaluate the effectivity of therapeutical applications of mindfulness, i.e., MBIs. Here, I will briefly present the most commonly mentioned measurements in related work. These are all purely self-reporting questionnaires. Other methods exist, such as the using of EEG-data (Electroencephalogram, measures electrical activity in the brain using electrodes attached to the head) of the meditator before, during and after a meditation session. [33] However, I choose to focus only on self-reporting questionnaires, as that is the most relevant to the current thesis.

Mindfulness Attention Awareness Scale (MAAS)   The Mindfulness Attention Awareness Scale was designed to assess the state of mindfulness of an individual over time. This scale thus measures informal mindfulness quality, or the extent to which an individual possesses the trait mindfulness. The MAAS consists of 15 questions that aim to assess the attention (or lack thereof) one pays to everyday activities and experiences. Participants are asked to evaluate each item on a six-point scale (almost always to almost never). Examples of the items include 'I could be experiencing some emotion and not be conscious of it until some time later' and 'I forget a person's name almost as soon as I've been told it the first time'.[34]

Toronto Mindfulness Scale (TMS)   The Toronto Mindfulness Scale assesses the quality of a just-performed formal mindfulness practice. Hence, it focuses on the quality of the state mindfulness of the individual. The TMS consists of 13 questions that aim to assess two factors: Curiosity and Decentering. Curiosity here means the attitude the individual has towards their own thoughts and feelings; to what extent do they want to learn more about these experiences. This factor is assessed using questions such as 'I was curious about what I might learn about myself by taking notice of how I react to certain thoughts, feelings, or sensations'. Decentering represents the change in the way one sees their own thoughts and feelings. This is the change where one goes from identifying personally with their own thoughts and feelings to being able to see them separately from their own self. Decentering is assessed by questions like 'I was more invested in just watching my experiences as they arose, than in figuring out what they could mean'. All items are assessed on a five-point scale (not at all, a little, moderately, quite a bit, very much). [35]

Critics of the TMS point out that it misses the main component of mindfulness as identified in [31], namely 'self-regulation of attention'.[33] The aspect 'attention' is the most prevalent aspect of mindfulness in the

literature review of Terzimehić [27], which indicates it is generally seen as an important aspect of mindfulness. However, the TMS was one of the earliest measurements for formal practices, and has as such been important in the development of more recent methods.

Five Facet Mindfulness Questionnaire (FFMQ)   The Five Facet Mindfulness Questionnaire combines questions from earlier defined mindfulness questionnaires, such as the MAAS, to assess the trait mindfulness based on five facets of mindfulness. These facets are (1) *nonreactivity* to inner experience, (2) *observing*/noticing/attending to sensations/perceptions/thoughts/feelings, (3) *acting with awareness*/automatic pilot/concentration/nondistraction, (4) *describing*/labelling with words, and (5) *nonjudging* of experience.[36] The italicised parts of the facets are the words by which I will refer to the facet later.

Practice Quality-Mindfulness (PQ-M)   In [37], the Practice Quality-Mindfulness (PQ-M) scale was proposed. They define mindfulness practice quality as "a balanced perseverance/resolve in (a) receptive (b) present-moment attention, during the act of formally practising mindfulness meditation". Thus, using the PQ-M, one can evaluate the state mindfulness right after a formal practice. The PQ-M consists of six questions that aim to measure either the perseverance or the receptivity of the meditator during the just-performed meditation session. Perseverance is measured by questions like 'During practice, I attempted to return to my present-moment experience, whether unpleasant, pleasant or neutral', receptivity by questions like 'During practice I was actively avoiding or "pushing away" certain experiences'. Answers should be given on a scale of 0% to 100%, indicating approximately how much time during the practice the meditator felt the statement was true. [37]

What constitutes a high-quality mindfulness

Formal practice and the quality of state mindfulness   When looking at the TMS and the PQ-M, the scales that measure state mindfulness right after a formal practice, we can identify apparently important aspects for a high quality formal mindfulness practice. As explained above, the TMS aims to assess the extent to which the meditator was curious during the practice, as well as the extent to which the meditator was able to separate themselves from their thoughts, emotions and experiences, i.e., Curiosity and Decentering. Critics found that the TMS lacks the important component 'self-regulation of attention'. The PQ-M measures the extent to which the meditator could and did control their attention towards the present-moment, with a curious and non-judging approach, as well as the extent to which they could accept the thoughts, emotions, and experiences that arose during the

practice. These two aspects are called Perseverance and Receptivity in the PQ-M.

For clarity, I choose to map these concepts onto slightly different aspects. I keep Curiosity as is. Perseverance can be split into two parts: Attention, and combining it with Decentering gives the aspect Non-judgmental. Receptivity is a combination of Curiosity and Attention. Hence, we can conclude that the following aspects are important to a high-quality state mindfulness:

- Curiosity: the meditator is curious about themselves and their experiences, thoughts, and emotions

- Non-judgmental: the meditator doesn't categorise experiences, thoughts and emotions, but rather just lets them be

- Acceptance: the meditator doesn't attach emotions to certain experiences and thoughts, but rather accepts that they are so, and doesn't attempt to fix or change them

- Attention: the meditator could sustain attention to the present-moment, and could return to this attention as soon as they noticed they were involved in a certain thought

Informal practice and the quality of trait mindfulness   To determine which aspects are important for a high-quality trait mindfulness, we turn to the FFMQ. I do not need to look at MAAS again, as this scale was already incorporated in FFMQ. As explained above, FFMQ was designed by analysing earlier measurements. Five facets were derived from these questionnaires: nonreactivity, observing, acting with awareness, describing, nonjudging

In later research, these five facets have been acknowledged as a proper conceptualisation of important aspects of trait mindfulness. [38] [39] Hence, I will use these five facets as well to construct the five characteristics of an individual that form a high-quality trait mindfulness.

- The individual is able to allow their thoughts and feelings to come and go without becoming involved or carried away with them (nonreactivity)

- The individual is able to observe/notice internal and external experiences (observing)

- The individual is able to attend to their activities in the moment as opposed to operating on "autopilot" (acting with awareness)

- The individual is able to label internal and external experiences with words (describing)

- The individual can accept their thoughts and feelings without evaluating them (nonjudging)

Formal and/or informal mindfulness practice   A question one could ask now is whether formal or informal mindfulness is better. I would argue that neither is better nor more important than the other, but that they are highly related but incomparable aspects of mindfulness in general. Both state mindfulness and trait mindfulness are underpinned by the seven attitudes that Job Kabat-Zinn identified [40]: non-judging, patience, a beginner's mind, trust, non-striving, acceptance, and letting go. In building and/or training state or trait mindfulness, one both builds on and trains these attitudes. They form the shared basis of a high-quality state mindfulness and a high-quality trait mindfulness.

In the rest of this thesis, I will continue to make the separation between state mindfulness, related to formal practice, and trait mindfulness, related to informal practice.

4.4   Possible risks and benefits of gamification

Critique of using gamification in mindfulness applications is mostly rather abstract, and in general (substantiated) speculations, instead of well-researched conclusions. Positive effects are generally found in experiments where participants were asked to use a certain gamified system for a certain amount of time. It is rather difficult to report the effect of individual gamification elements, since studies generally don't measure their independent effects, but rather measure the addition of gamification in general.

Goal of using gamification

In the vast majority of use-cases, gamification is used with improved engagement in mind [41]. However, motivation is only 1 of the drivers of behaviour change, the other two being opportunity and capability [17]. The lack of focus on the latter two leads to an over-representation of gameful elements focused on improving engagement, as opposed to a balanced system [16].

Measured effects

In a study on the effectiveness of the gamification of mindfulness in reducing depression, Headspace was used [7]. It was found that Headspace, by using gamification elements, provided the user with the necessary extrinsic motivation to use the app daily, and be reminded to focus on the present moment, and in doing so reduced depression. Many other studies also found indications that gamification is effective in motivating users to keep using the application, e.g., [42], [43] and [44]. As [45] point out, reward, such

as points and badges, are key in motivating users to keep engaging in the system regularly. Likewise, social comparison and social networking seem to lead to improved engagement with the system [16]. Tailoring, i.e., Customisation, is promising as well, as it increases the level of autonomy of the user. This would lead to more intrinsic motivation [17], the importance of which will be explored more below.

Additionally, [41] found that these benefits are not only experienced by users who were already motivated to use the system, but that gamification is also effective for those without pre-existing motivation for the activity.

However, there are many studies where no positive effects were measured. For example, in a study that compared a gamified and a non-gamified version of the same app, the gamified app showed no greater engagement or results than the non-gamified version [46]. Simple, direct tracking features were appreciated more than gamification elements such as badges and social networking, reportedly because this supported their autonomy more. More mixed results and associated possible explanations are discussed in the rest of this section.

Extrinsic vs intrinsic motivation

Many articles mentioning risks associated with gamification relate gamification with extrinsic motivation, arguing that intrinsic motivation should be a preferable goal. Intrinsic motivation describes performing an activity for the sake of the activity itself; the individual enjoys the activity and/or gets personal fulfilment out of it. On the other hand, extrinsic motivation describes performing an activity for the sake of extrinsic rewards. One can easily see how gamification feeds extrinsic motivation. By performing the activity, the user gets badges, points, a higher spot on the leaderboard, or can show off to other users.

Behaviour change based on intrinsic motivation is more sustainable than behaviour change based on extrinsic motivation [41]. However, in most application fields of gamification, it is not necessarily seen as a problem that gamification feeds extrinsic motivation, since the activity is often seen as a means to an end [14]. For example, running is seen as a means to increase fitness, so by extrinsically motivating people to run, the road towards the goal becomes easier [41].

Within the realm of mindfulness, however, the focus on extrinsic motivation is seen as a problem. This is both pointed out by participants in mindfulness studies, researchers, and mindfulness teachers.

When asked whether the addition of gamification elements to a non-gamified mindfulness application they had used would be a good idea, participants indicated that they thought this was not a good idea, as they felt it would reduce their autonomous motivation, and instead put their focus on external rewards [47]. Mindfulness teachers share this view [3].

They were, however, divided on whether this was completely a bad thing. Some interviewed mindfulness teachers admitted that the use of gamification could give an initial burst of extrinsic motivation, helping an individual get started with their mindfulness practice. Others only mentioned their worry that gamification would limit/counteract intrinsic motivation.

Even though many researchers recognise the importance of intrinsic motivation, [41] points out that gamification often still effectively only engenders extrinsic motivation techniques. They note that no study included in their review captured intrinsic motivation as either direct outcome or mediator, and instead only capture extrinsic motivation.

Novelty effect

Very little is known about the long-term effect of gamification. In an early literature review on gamification[48], it was noted that it is far from certain that gamification—even if it is very effective in terms of engagement in the early days—is an effective method in the long-term. They ascribe this possibility to novelty effect.

Apart from facing possible declining effects of gamification after the novelty period, one could face a different problem upon deciding whether or not to keep already present gamification elements: loss aversion and reliance on gamification elements [49]. Loss aversion here is the way users seem to become disengaged once their earned badges and points are removed [48]. This is related to the reliance on gamification elements as mentioned by [49]. Upon deleting the gamification elements in a gamified system, they found that usage of the website decreased considerably. This could suggest that gamification keeps being effective, even after a longer time. However, in the light of mindfulness, it highlights a risk, namely that of overreliance on extrinsic motivation. On the other hand, besides this circumstantial evidence, there is little to no evidence that gamification is still effective after the novelty phase.

Beginners vs non-beginners

There seems to be a difference in the effectiveness of gamification between users who are new to the system onto which gamification is applied and users who are already familiar with the system [41]. Gamification only seems to be effective for beginners, whereas non-beginners experience gamification more as a nuisance. For example, gamification in a fitness tool helped beginners to incorporate exercise in their daily activities, while non-beginners found that the gamification elements were in the way of their progress, as they dictated the pace of progression. Additionally, praise was liked by beginners, while non-beginners considered it exaggerated, not in line with the performance.

Personality traits

Apart from the ways gamification can inherently help or limit one's mindfulness practice, another relevant factor in whether gamification is effective is the user's personality, and specifically to what extent the user is sensitive to rewards.

For example, [9] found that the addition of gamification elements to an already effective mental health application does not seem to improve the positive effect of the intervention for users experiencing depressive symptoms. It reduces neither the depressive symptoms, nor does it increase usage frequency or adherence. They argue that this could either be because the intervention is already effective 'enough', and the addition of gamification just doesn't do anything extra. Another explanation offered has to do with reward sensitivity. People with depression are less sensitive to rewards [50], so the effect of gamification for individuals with depressive symptoms could be less strong than for those without.

Apart from that, there is very little research on the relation between personality traits and gamification, let alone on the possibly varying effects of gamification in (mental) health applications between different personalities. There seems to be a difference in the effects of gamification between introverted and extroverted individuals. [51] find that extroverted people seem to be more sensitive to competitive gamification elements, such as leaderboards. However, [52] find that introverted people gain more effect of leaderboards, while extroverted people seem to gain more from points and badges.

Interestingly, [51] found that people with higher emotional stability seem to gain less from gamification, and even react negatively to the gameful elements. High emotional stability here corresponds to low neuroticism and is defined as having "emotional maturity, self-confidence, and stability in their plans and affections" [51]. These are qualities that are nurtured by the mindfulness practice (see Aspects of a high-quality mindfulness practice. This might also explain why non-beginners seem to perceive fewer benefits from gamification than beginners do.

Appropriateness

Often the question is raised whether it is even appropriate to apply gamification to mindfulness applications, related to the critique raised above on the extrinsically motivating nature of gamification. For example, in [9], the authors point out that the use of leaderboards encourages social comparison, which could limit the positive effect of the intervention on the user's mental health. [17] also points out that gamification elements may be less suitable in mental health applications, especially if the users potentially are in distress.

In interviews about digitalised mindfulness, as well as specifically the gamification aspect of this digitalisation, mindfulness teachers raise questions behind the use of gamification in mindfulness applications [3]. They explain the importance of a coherent, so-called container. The container forms the context in which the mindfulness practice exist, and inherently only covers formal practices. According to the teachers, such a container is especially important for beginners, who are still training their "mindfulness muscle". When talking about an offline practice, such a container encompasses both physical aspects (the layout and design of the room, sounds or smells created, etc) and non-physical aspects (the way the teacher approaches students and the norms they set). The container is important to put the meditator in the right mindset, to make them feel safe and have the feeling they won't be judged in any way. This extends to the container of an online practice: a mindfulness application should be designed in such a way that it expresses the same feeling as well as encourages students to make their own physical container to extend this digital part. As mentioned, this container should be coherent, a unified whole. When looking at gamification, they identify three aspects where gamification may either be detrimental to this coherency [3]:

- Focusing, not distracting: gamification elements could distract from the mindfulness practice. For example, ads, an overload of notifications and 'high-fiving' other users (as in Insight Timer) were mentioned by teachers as possibly distracting the user from a mindful state. The teachers expressed concern that gamification could undermine mindfulness, trivialising the transformative journey by adding 'patronizing gold stars'.

- Social support, not social comparison: in the eyes of the mindfulness teachers, comparison contradicts a mindfulness mindset, referring to the quality non-judgment of mindfulness. Not only gamification elements inherently designed for users to compare themselves to other users pose a risk to this quality. Teachers also think measurements like daily streaks might encourage comparison, and thus judging. Social networking elements could help with social support, but could implicitly encourage social comparison, as well as be distracting.

- Process-oriented, not achievement-oriented: inherently, mindfulness calls for focusing on the current moment. If, however, progress is measured by badges or visually linear graphs, an application seems to put the focus on the future, on some goal. Especially related to this, teachers were concerned that gamification is inherently antithetical to mindfulness. The mindfulness teachers see some benefit in instead visualising the development process, for example by a growing tree.

Even though the following is not directly applied to mindfulness, it illustrates the point that gamification might not be suitable for mindfulness applications, if the goal is to gain a higher quality mindfulness. The argument, made by [53], is that the addition of gamification elements inherently brings a certain bias, just as traditional digital games present a certain biased representation of the world [54]. By providing only certain tracking measures, a user might lose sight of what they personally find important of the activity. For example, the Nike+ system only provides the possibility to track distance and duration of a run. In doing so, it implicitly deems other aspects, like a runner's high, less important. [16] One can see how keeping track of duration and streak-records of one's mindfulness practice, a user may start measuring the quality of their mindfulness practice only by these measures, losing focus on the actually important aspects of a high-quality mindfulness practice as found in Aspects of a high-quality mindfulness practice.

To counter the raised concerns about gamification of digital mindfulness, mindfulness teachers take a positive stance towards (gentle) notifications reminding a user to focus on the current moment, such as the Mindful Moments offered by Headspace [3]. They see these reminders as a possible bridge to make a transition from purely formal practices to a daily life based on informal mindfulness practice. Additionally, they argue that mindfulness applications could help take this step by letting a user set personalised intentions at the end of a formal practice to help them transfer the mindfulness state in their day-to-day activities. If gamification is directly and intentionally used to bridge the gap between formal mindfulness practice and building a trait mindfulness, it would be appropriate, and could even be beneficial, according to the mindfulness teachers.

Additionally, gamification could help build a regular practice, when used as scaffolding, i.e., as training wheels for a beginner, slowly being removed as the user gets more experienced. [3] This way, a user gets help in building the necessary adherence to the mindfulness practice [8], by using extrinsic motivation in the beginning, slowly transitioning into intrinsic motivation as the scaffolding is reduced.

Conclusion

As explored in this section, there are many aspects to the question whether gamification would be beneficial to mindfulness. Here, I will present an overview of the found possible benefits and risks of adding gameful elements to mindfulness applications.

Possible benefits
- Gamification can lead to improved engagement with the system, and thus increase the quantity of mindfulness meditation session. Seeing

the importance of adherence to mindfulness practices [8], this would be a positive effect. This is especially helpful in the beginning of one's mindfulness journey.

- Customisation could lead to an increased feeling of autonomy, which helps to increase intrinsic motivation

- Social networking can lead to a feeling of social support, which helps in creating a safe container

- Gentle reminders to turn one's focus to the present moment could help bridge the gap between formal and informal practices

Possible risks

- Gamification generally only promotes extrinsic motivation, which is less sustainable than intrinsic motivation. The result could be an overreliance on extrinsic motivation.

- Gamification (especially Badges or achievements and Social networking) could thwart the feeling of autonomy

- There seems to be a difference in the way individuals perceive gamification related to their reward sensitivity, extraversion/introversion and their emotional stability (neuroticism)

- Gamification might not be suitable for non-beginners, as they seem to perceive it more as a nuisance, and their emotional stability is often stronger (see previous point)

- Social comparison, as well as Badges or achievements and Levels or progress feedback promote comparing mind, which is limiting to a mindful state

- Badges or achievements and Levels or progress feedback put the focus on external goals instead of the current moment, which inherently thwarts a mindful state

- Gameful elements could be distracting, thwarting the mindful state of the individual

4.5 Questionnaire 2

On the second survey, 56 responses were received. Three respondents answered 'no' to the question '*Have you read and understood the above information, do you agree to participate, are you at least 18 years old and at most 25 years old and have you used a mindfulness application at least a*

few times?'. These three responses were discarded. The remaining 53 were used.

The questions regarding the perceived effects of gamification in the mindfulness applications (i.e., the last section of the questionnaire) were split into multiple categories, where four questions were discarded all together. The categories are related to the possible benefits and risks as presented above:

- Possible positive effects

    - Increased engagement
    - Increased feeling of autonomy
    - Increased feeling of social support
    - Bridging the gap to informal practice

- Possible negative effects

    - Overreliance on gameful elements
    - Comparing mind
    - Distracting from state mindfulness

The statements '*I feel more in control of my mindfulness journey because I can work towards new badges/milestones*' and '*I feel more in control of my mindfulness journey because I can share my progress with buddies/friends*' were meant to measure detrimental effects of the relative gamification elements to the autonomy of the user. However, upon reflection, I realised that these statements won't measure this effect, and hence should not be included in the results. Furthermore, the questions '*I find myself returning to the app to earn new badges/milestones*' and '*I find myself returning to the app just to save my streak*' were meant to measure the extent to which participants focus on external goals instead of relying on intrinsic motivation. However, I realised that these statements merely measure engagement levels, which is already done by other questions. Hence, these two statements were also discarded.

The five-point scale questions were converted to numerals according to the following conversion:

- Strongly disagree/Never or very rarely true: 1

- Disagree/Rarely true: 2

- Neutral/undecided/Sometimes true: 3

- Agree/Often true: 4

- Strongly agree/Very often or always true: 5

- N/A: null

Usage of mindfulness applications

In figure 4.4, the mindfulness applications used by the respondents of this second questionnaire are reported, split in the apps reported by those still using mindfulness applications and the apps reported by those not using mindfulness applications any more. In figure 4.5, you can find the reasons respondents reported for choosing their most-used applications in particular, as well as the reason to continue using this app for those relevant.
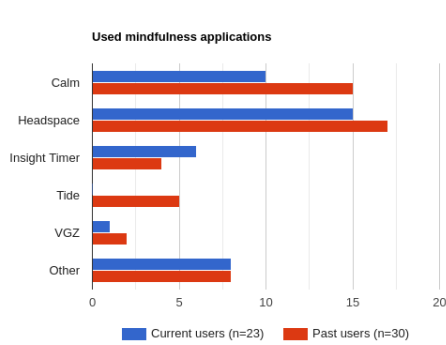

Figure 4.4: Used applications by respondents (questionnaire 2)
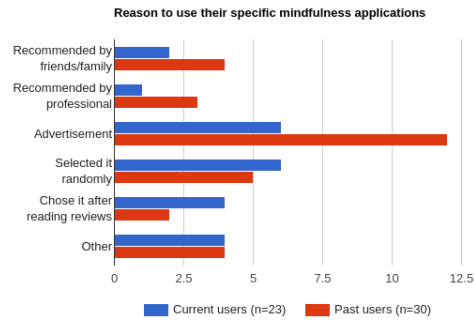
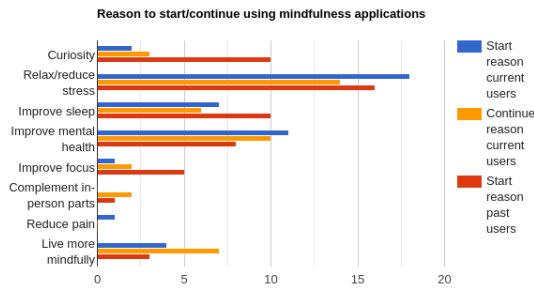Figure 4.5: Reasons why respondents use(d) their particular application (questionnaire 2)

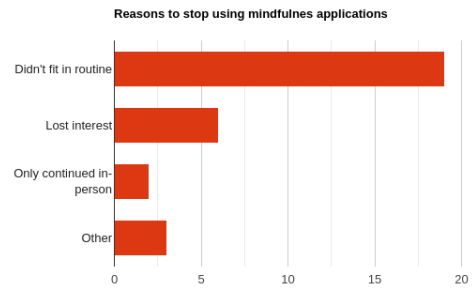Figure 4.6: Reasons to start and continue using mindfulness applications (questionnaire 2)

Figure 4.7: Reasons to stop continue using mindfulness applications (questionnaire 2)

In figure 4.6, you can find the reasons respondents gave for starting and continuing using mindfulness applications. In figure 4.7, the reasons respon-

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dents gave for not continuing using mindfulness applications are reported. Naturally, this only includes participants who don't use mindfulness applications any more.

In table 4.2, the length of usage of the respondents can be found. The rows indicate the starting moment of the users, the columns stand for the last time they used mindfulness applications, or 'current users' for those who haven't stopped using them.

	Current users	5+ years ago	2-5 years ago	1-2 years ago	< 1 year ago	<3 months ago
5+ years ago	5	-	4	-	2	-
2-5 years ago	8	-	5	5	2	2
1-2 years ago	5	-	1	4	2	-
< 1 year ago	4	-	-	-	1	2
< 3 months ago	1	-	-	-	-	-

Table 4.2: When did the respondents start using mindfulness applications (rows) and when did they stop using them (columns)

Personality traits and FFMQ scores

In figure 4.8, you can find the rating respondents gave themselves on the scale of absolute extravert to absolute introvert. In figure 4.9, the answers to the question '*Would you describe yourself as being sensitive to rewards*' can be found. For both these questions, all respondents are included (both current and past users).
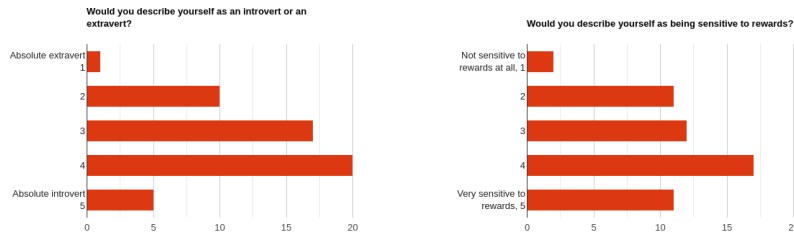

Figure 4.8: Would you describe yourself as an introvert or an extravert?

Figure 4.9: Would you describe yourself as being sensitive to rewards?

In figure 4.10, the FFMQ scores of the respondents are visualised. The respondents are split on their usage frequency of the mindfulness application.
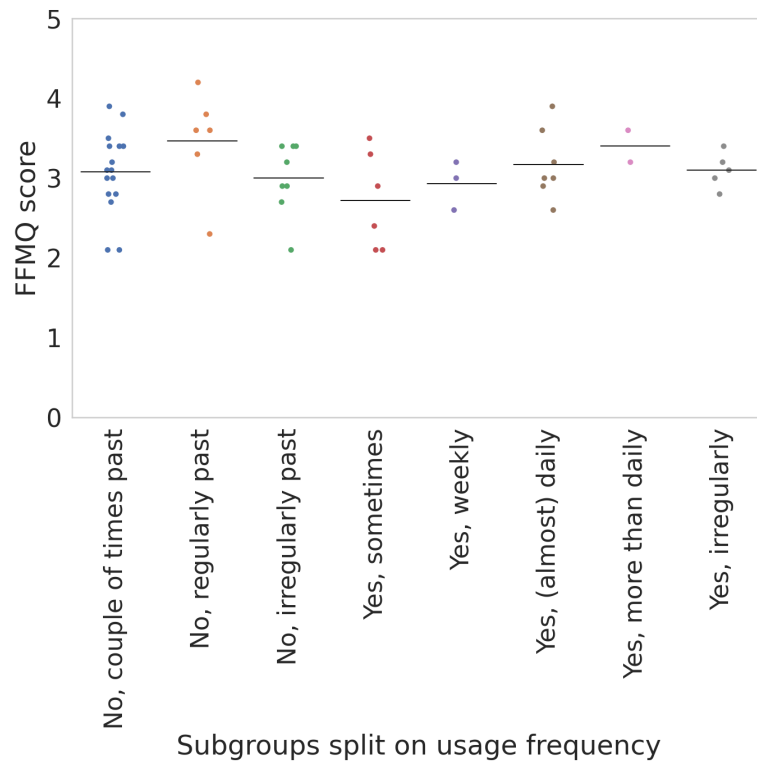
Figure 4.10: FFMQ score split per participant group

Reported perception of gamification

In table 4.3, the quantified reported perception of gamification are presented split by both possible effects of gamification on mindfulness and by participant group (split by usage frequency).

	All (n=53)	Past users (n=30)	No, couple times past (n=16)	No, regularly past (n=6)	No, irregularly past (n=8)	Current users (n=23)	Yes, sometimes (n=6)	Yes, weekly (n=3)	Yes, (almost) daily (n=7)	Yes, more than daily (n=2)	Yes, irregularly (n=5)
Possible positive effects	2.64	2.63	3.07	2.35	2.43	2.65	3.0	3.76	2.92	3.43	3.07
Increased engament	2.45	2.54	2.99	1.8	2.36	2.35	2.8	3.47	1.71	2.55	1.88
Increased feeling of autonomy	3.33	3.29	3.61	3.33	2.8	3.39	2.67	3.89	3.4	3.67	3.75
Increased feeling of social support	2.91	2.5	2.83	2.17	2.21	3.47	3.6	4.0	3.0	4.0	3.5
Bridging gap to informal practice	2.89	2.59	2.86	2.08	2.36	3.31	2.92	3.67	3.58	3.5	3.13
Possible negative effects	2.17	2.38	2.66	1.63	2.35	1.9	2.41	2.87	1.39	1.32	1.53
Overreliance on gameful elements	2.26	2.49	2.69	1.7	2.74	1.96	2.36	2.89	1.36	1.58	1.92
Comparing mind	2.17	2.36	2.58	1.75	2.47	1.94	2.63	2.83	1.62	1.13	1.19
Distracting from state mindfulness	1.99	2.17	2.72	1.44	1.83	1.75	2.23	2.89	1.19	1.25	1.5

Table 4.3: Perceived effects of gamification per participant group (columns) and per possible risk and benefit effect (rows)

FFMQ and perception of gamification by length of usage In table 4.4, you can find both the FFMQ scores and the quantified reported perception of gamification again, but now the users are split by the moment they first started using mindfulness applications. The current users are kept separate from those that are no longer using mindfulness applications because the first give more relevant data.

	All (n=53)	All current users (n=23)	started 5+ years ago (n=5)	started 2-5 years ago (n=8)	started 1-2 years ago (n=5)	started < 1 year ago (n=4)	started < 3 months ago (n=1)	All past users (n=30)	started 5+ years ago (n=6)	started 2-5 years ago (n=14)	started 1-2 years ago (n=7)	started < 1 year ago (n=3)	started < 3 months ago (n=0)
FFMQ score	3.09	3.03	3.14	2.97	3.08	3.05	2.6	3.14	3.58	2.96	3.07	3.23	nan
Possible positive effects	2.64	2.65	1.96	2.66	3.45	2.82	2.1	2.63	2.41	2.17	3.34	3.56	nan
Increased engagement	2.45	2.35	1.63	2.34	3.28	2.74	1.63	2.54	2.18	2.19	3.35	3.37	nan
Increased feeling of autonomy	3.33	3.39	2.67	3.81	3.89	2.89	4.0	3.29	3.56	2.82	4.5	3.17	nan
Increased feeling of social support	2.91	3.47	2.7	3.5	4.38	3.5	nan	2.5	2.0	1.92	3.75	3.5	nan
Bridging gap to informal practice	2.89	3.31	2.5	3.44	3.88	3.5	nan	2.59	2.5	2.19	3.0	3.5	nan
Possible negative effects	2.17	1.9	1.5	1.38	3.18	2.29	1.44	2.38	1.9	2.15	3.0	3.15	nan
Overreliance on gameful elements	2.26	1.96	1.53	1.35	3.38	2.54	1.0	2.49	1.97	2.41	2.81	3.22	nan
Comparing mind	2.17	1.94	1.6	1.35	2.81	2.38	3.0	2.36	1.5	2.31	3.29	2.5	nan
Distracting from state mindfulness	1.99	1.75	1.33	1.4	3.13	1.67	1.0	2.17	2.22	1.64	3.1	2.83	nan

Table 4.4: Perceived effects of gamification and FFMQ score per participant group (columns) and per possible risk and benefit effect (rows)

FFMQ and perception of gamification by personality trait In table 4.5, data on the relation between the FFMQ scores and quantified reported perception of gamification can be found and certain personality traits of the respondents can be found.

	All	Absolute extravert to absolute introvert					Not sensitive to very sensitive to rewards				
		1 (n=1)	2 (n=10)	3 (n=17)	4 (n=20)	5 (n=5)	1 (n=2)	2 (n=11)	3 (n=12)	4 (n=17)	5 (n=11)
FFMQ score	3.09	3.9	3.04	3.11	2.99	3.32	4.05	3.0	3.27	3.05	2.87
Possible positive effects	2.64	2.54	3.28	2.42	2.59	2.40	1.47	2.56	2.69	2.61	2.91
Increased engagement	2.45	2.6	3.26	1.99	2.49	2.23	1.05	2.25	2.59	2.49	2.7
Increased feeling of autonomy	3.33	nan	3.46	3.24	3.27	3.6	5.0	3.1	3.03	3.62	3.37
Increased feeling of social support	2.91	4.0	3.38	2.42	3.22	1.75	1.0	2.45	3.0	3.21	3.38
Bridging gap to informal practice	2.89	1.5	3.0	3.1	2.93	2.2	3.0	2.73	2.77	2.9	3.14
Possible negative effects	2.17	2.4	2.76	1.87	2.23	1.82	1.0	2.12	2.57	2.03	2.22
Overreliance on gameful elements	2.26	2.0	2.57	2.02	2.38	1.93	1.0	2.06	2.82	2.23	2.15
Comparing mind	2.17	3.0	2.97	1.75	2.24	1.57	1.0	1.96	2.44	2.02	2.53
Distracting from state mindfulness	1.99	2.67	3.08	1.54	1.87	1.87	1.0	2.07	2.47	1.54	2.07

Table 4.5: Perceived effects of gamification and FFMQ score per participant group (columns) and per possible positive and negative effect (rows)

Correlations

In table 4.6, you can find a correlation matrix. In this matrix, a few questions are directly taken (e.g., the answers to the questions about extra-/introversion and reward sensitivity), and other variables come from taking the average from multiple questions (e.g., the 'Increased engagement' data includes all questions related to the perceived effect gamification has on the respondents' engagement). To clarify: 'Possible positive effects' and 'Possible negative effects' cover all the data of the corresponding subcategories combined. We can see that the correlation between possible negative effects and possible positive effects is 0.72. For current users, this correlation is slightly lower at 0.64, while the correlation for past users, it is slightly higher at 0.78.

		Introvert/extravert	Reward sensitivity	FFMQ score	Possible positive effects	Increased engagement	Increased feeling of autonomy	Increased feeling of social support	Bridging gap to informal practice	Possible negative effects	Overreliance on gameful elements	Comparing mind	Distracting from state mindfulness
		1	2	3	4	5	6	7	8	9	10	11	12
Introvert/extravert	1	1.0											
Reward sensitivity	2	-0.21	1.0										
FFMQ score	3	-0.03	-0.28	1.0									
Possible positive effects	4	-0.18	0.22	-0.2	1.0								
Increased engagement	5	-0.19	0.24	-0.22	0.97	1.0							
Increased feeling of autonomy	6	0.01	0.06	-0.15	0.64	0.48	1.0						
Increased feeling of social support	7	-0.17	0.35	-0.15	0.7	0.61	0.5	1.0					
Bridging gap to informal practice	8	-0.08	0.11	-0.03	0.43	0.35	0.29	0.42	1.0				
Possible negative effects	9	-0.16	0.06	-0.14	0.72	0.77	0.24	0.47	0.27	1.0			
Overreliance on gameful elements	10	-0.06	0.08	-0.17	0.53	0.58	0.04	0.31	0.19	0.92	1.0		
Comparing mind	11	-0.27	0.19	-0.23	0.58	0.62	0.21	0.47	0.21	0.83	0.67	1.0	
Distracting from state mindfulness	12	-0.24	-0.03	-0.03	0.76	0.79	0.34	0.42	0.32	0.8	0.54	0.59	1.0

Table 4.6: Correlations between selected pairs of data of questionnaire 2

Chapter 5

Discussion

In this chapter, I will first summarise the main findings of this thesis. Then, I will analyse and discuss the results presented in this thesis in more detail, and finally, I will reflect on the research performed and consider some limitations and possible future directions.

5.1 Main findings

The data generated by this thesis were far from unambiguous enough to present here very clear answers to our research question. However, the goal was to identify trends in the use of gamification in mindfulness, and the effect that has on its users and the quality of their practice. This we can do based on the results in this thesis.

Overall, it seems that all possible benefits of using gamification found indeed are experienced as having a positive effect on the mindfulness practice of users. Conversely, the possible risks of using gamification in mindfulness applications also seem to be grounded in some truth. However, the positive effects are experienced to a greater extent than the negative effects, speaking for the use of gamification in mindfulness applications, even though there are some downsides.

The main reason past users reported for not continuing using mindfulness applications was that it disappeared from their routine or that they weren't able to incorporate it in their routine in the first place. Decidedly, they didn't choose '*I lost interest in mindfulness/meditation*, thus implicitly reporting that they would have liked to incorporate mindfulness in their day-to-day routines. Even though the scores for gameful elements promoting engagement with the applications are not convincingly high, this finding still suggests that there is more potential for motivating users with gameful elements.

It was found that multiple earlier studies suggested that gameful elements might be less suitable for non-beginners. Based on the results from

our second questionnaire, we can't confirm that non-beginners experience gameful elements as a real nuisance, but they do seem to be more indifferent towards these elements. On the one hand, this suggests that there is no harm in presenting a gamified system to more veteran mindfulness practitioners. On the other hand, this also provides potential to personalise the experience more. For example, when a user is becoming more experienced, the app could start to make the gameful elements less prominent, slowly removing the training wheels so to speak. It could do so, for instance, by suggesting to the user that they might be ready to rely on their intrinsic motivation to continue.

A gameful element that was expected to actually indirectly support intrinsic motivation was Customisation. Customisation could promote a feeling of control, which leads to an increased feeling of autonomy, which supports intrinsic motivation. This category being the highest rated category of gamification in the second questionnaire, we can argue that this poses a positive effect from using gamification. This finding strengthens the suggestion that users should be able, and advised, to take more control over their mindfulness practice at some point, allowing the training wheels to come off.

A category of gameful elements that might not need to be hidden at some point during a user's mindfulness journey is that of social networking. It seems that the belief that social networking elements might play an important role in creating a safe container within the app, is indeed very plausible.

Possibly the most important possible risk of gamification in mindfulness is the promotion of a comparing mind, suggesting to users, for example that that buddy with a higher streak is doing better. This risk seems to be grounded in some truth, although only moderately, and should be taken seriously as a comparing mind very directly opposes the important aspect 'non-judgment' of mindfulness. Additionally, there is a low negative correlation between the quality of trait mindfulness of the respondents and their rated gamification experiences. This could mean that the more one engages in gamification elements, the lower their FFMQ score, and hence quality of trait mindfulness will be.

Concluding, we found that most suspected benefits as well as the suspected risks seem to be legitimate.

5.2 Analysis of results

This section will mainly contain the analysis of the data generated through the second questionnaire. The first questionnaire only contained a few questions to give a feeling of the target population. The interpretation of this data was necessary to continue to the subsequent research components, and

thus has already been discussed in the previous chapter (Questionnaire 1. The second component was the analysis of the most-used applications using the taxonomy of [17] Since the results of the first three sub-questions were needed in order to progress to subsequent sub-questions, interpretations the majority of the result analysis for these three has already been presented in the previous chapter. Hence, I will discuss these results in the light of the entire thesis here shortly, and focus on interpreting the results of the second questionnaire.

5.2.1 Questionnaire 1

The first questionnaire in this thesis was mainly meant to give an overview of the used mindfulness applications amongst the target population. Some additional questions were included to get an initial feel for the usage patterns of and motivations to using these applications. Even though the number of respondents was rather low (31 usable responses), it was clear that Headspace, Calm, and Insight Timer were regularly used. To broaden the gamification analysis, we decided to include Tide and VGZ Mindfulness Coach in further analysis as well. With the first only having 3, and the latter only having 2 users amongst the respondents, it was rather arbitrary that these were chosen instead of other applications with only 1 user. However, as we will later see, the choice wasn't a bad one, and would have helped to find out certain trends either way.

5.2.2 Analysis of most-used applications

The second component of this research project was to apply [17]'s taxonomy on the most-used applications as found in the first questionnaire. We saw that the majority of possible gameful elements are not present in the analysed mindfulness applications, while some are present in the majority of the applications. Customisation, Levels, or progress feedback and Personalisation were present in all but VGZ Mindfulness Coach, which didn't include any gameful elements. My initial thought after discovering this last point was that this would give the opportunity for interesting comparisons between VGZ users and other applications. However, there was an unfortunately low number of VGZ users amongst the respondents in the second questionnaire, and neither of them user solely VGZ but instead used gamified mindfulness applications as well.

5.2.3 Aspects of a high-quality mindfulness practice

Because there was no clear, undisputed overview of aspects that form a high-quality mindfulness, I set out to make such an overview myself relevant to this thesis. This, inevitably, leads to a subjective overview. However, I have

tried my best to present a broad view on the existing literature and to argue why we ended up with the overview we did.

5.2.4   Possible risks and benefits of gamification

Just as above, the fact that I performed a non-systematic literature review to answer the question of what the possible risks and benefits of gamification are, means that the answer is inherently subjective. Again, I have tried my best to include as diverse a literature overview as possible, and tried to explain clearly how I got from that pool of literature to the overview of possible risks and benefits.

5.2.5   Questionnaire 2

General data

Comparing figure 4.4 with figure 4.1, we can see that the respondents for the second questionnaire use approximately the same applications as the respondents of the first questionnaire. This strengthens the view we had of the mindfulness applications used by our target group, and means the gamification taxonomy we performed seems indeed relevant.

I won't go into too much detail for the more general questions of the second questionnaire, since the data isn't that interesting. I would like to point to the fact that the reason 'To live more mindfully' was more regularly mentioned as a reason to continue using mindfulness applications than as a start reason (figure 4.6). This could suggest that trait mindfulness becomes more important when a user is no longer a beginner. Additionally, we can see that the most important reason respondents didn't continue using mindfulness applications is that they didn't manage to incorporate it in their routine or that it disappeared from their routine (figure 4.7).

Correlation possible positive and possible negative effects gamification

Reasoning about the expected relation between the possible positive and possible negative effects gamification has on the quality of mindfulness, one could expect a negative correlation. If the possible benefits are indeed experienced as positive, i.e., users experience the described positive effects often or strongly, so they are given high scores, one could expect that the negative effects are felt less strongly. Thus, the scores given on statements describing negative effects of gamification would be low. Hence, if this would be the case, you would have a negative correlation. However, a strong positive correlation of 0.72 was found between the scores given to the statements about positive effects and the those given to the statements about negative effects (table 4.6). None of the scores are particularly strong (the highest

being 3.33 for an increased feeling of autonomy), which would explain a less strong negative correlation, but not necessarily a positive correlation. The finding of this strong positive correlation suggests that users experience both the positive and the negative effects of gamification to a somewhat similar extent. We can see that the positive effects are experienced slightly stronger (2.64 on average) than the negative effects (2.17 on average). These findings seemingly suggest that both the raised critiques as well as the predicted benefits of gamification are legitimate. Below, I will discuss these possible risks and benefits separately.

Correlations FFMQ scores and gamification ratings

In this thesis, we ask ourselves what the effect of gamification is on the quality of mindfulness. Hence, we take a look at the correlation between the FFMQ scores and the gamification ratings in table 4.6. We see that there is a low correlation for each of the gamification categories with FFMQ scores. This means that when the FFMQ scores are higher, the gamification elements are rated a little higher, hence as being experienced more prominently (and/or the other way around). This result is not unexpected and affirms the suspicion that a higher quality mindfulness makes individuals less likely to engage with gamification elements. It could also be interpreted as meaning that the more one engages in gamification elements, the lower their FFMQ score, and hence quality of trait mindfulness will be.

Possible benefit: Increased engagement

To explore the effect gamification has on the feeling of engagement, we take a look at table 4.3. We see that users gave these questions a moderate rating of 2.45, and there is only a small difference between the rating past users gave these questions (2.54) and current users (2.35).

From the past users, the respondents who used mindfulness applications regularly, but have since stopped using them, reported the lowest average score (1.8) to the questions related to increased engagement because of gamification. Their thinking in answering this question could be in the line of '*I once used the app regularly, but I don't any more, so clearly it didn't help in keeping me motivated to use the app*'. On the other hand, the respondents who used mindfulness applications only a few times reported a relatively high rating (2.99), of whom you could expect the same reasoning. This is also the case for those who used the app irregularly (2.36).

Looking at the current users, we see a wider range of ratings. The highest score (3.47) got reported by those who use mindfulness applications once or twice a week, the lowest score (1.71) by those who use them multiple times a week or daily. Given their very similar using patterns, this suggests that the experience of increased engagement doesn't depend on the usage

pattern, but might be due to another difference between users. Looking instead at table 4.4, we can't find a pattern based on the length of the use of mindfulness applications either.

Possible benefit: Increased feeling of autonomy due to customisation

The second possible benefit found in Possible risks and benefits of gamification was the suspicion that the gameful element Customisation could promote a feeling of control, hence a feeling of autonomy, which supports intrinsic motivation. The answers to the second questionnaire seem to support this theory, as the questions related to this possible positive effects formed overall the highest rated category at 3.33 (3.29 for past users and 3.39 for current users).

Possible benefit: Increased feeling of social support due to social networking

The ratings given to the experienced effect of social networking form the category with the biggest difference between past and current users. To the questions '*I feel less alone in my mindfulness practice when reading stories/experiences from other users on the shared feed*' and '*I feel less alone in my mindfulness practice when buddies/friends message me*', past users gave an average rating of 2.5, where current users gave a high score of 3.47. This high score seems to suggest that the social networking options support the creation of a safe container, as explained in Possible risks and benefits of gamification, which is beneficial to the mindfulness practice. I don't know why there is such a big difference between past users and current users.

Possible benefit: Bridging the gap to informal practice by (setting) reminders

The last possible benefit we will explore here is the possible positive effect (setting) reminders have on helping the user bridge the gap from formal practices to informal practice, hence helping to train trait mindfulness directly. We see that these questions were generally rated moderately (2.89), with relatively small differences between user-groups. This suggests that the ability to personalise these reminders and the reminders themselves are generally experienced as having a positive effect on the mindfulness practice of the respondents.

Possible risk: Overreliance on gamification for motivation

The first possible risk we will explore here is the risk of overreliance on gameful elements. The highest ratings come from the participants who used

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mindfulness applications a couple of times or irregularly in the past, and from those who currently use them once or twice a week (2.89). A surprising difference can be seen between this last group and those who use mindfulness applications multiple times a week or daily. The latter rated these statements only on an average 1.36. I am not sure what could be the underlying cause of this difference. The lowest ratings come from those using the mindfulness applications most often (multiple times a week or daily (1.36, or multiple times a day (1.58). I will discuss this finding when discussing the suitability of gamification for (non-)beginners below.

Given that this is the highest rated possible risk, this is probably the most legitimate suspected disadvantage of gamification in mindfulness application. On the other hand, a reliance on gamification elements to return to the app, does also mean that the user actually returns to the app and practices mindfulness. Here, we arrive again at the question whether it is a bad thing that someone only returns to practice to keep their streak intact, even though such external motivation might be less true to a high-quality mindfulness practice than intrinsically motivated practice. A relevant finding to this question is that the scores given to the possible positive effect of increased engagement and to the possible risk of overreliance on gameful elements are very close to each other, namely 2.45 for the first and 2.26 for the latter. Neither positive nor negative effect outplays the other, so this data doesn't necessarily give ground to argue for one side or the other to be more important.

Possible risk: Not equally suited for beginners and non-beginners

To explore the possible difference in perception of gamification between beginners and non-beginners, we take a look at table 4.4. We focus on the data by current users, since we more reliably know how long they have been practising mindfulness. Note that we do not know whether they took long breaks off of practising mindfulness during the time since they started using mindfulness applications, and whether they practised mindfulness before starting using mindfulness applications. Unfortunately, only one of the respondents started within the past 3 months, making our data on actual beginners next to non-existent. However, we can see that the longest users reported the lowest rating on the possible positive effects. Hence, they perceive the least benefits from gameful elements. This group, and those who started 2-5 years ago, report lower ratings on the possible negative effects than those who started in 1-2 years ago or in the past year. This would mean that the more veteran users also experience the least negative effects of gamification. This result suggests that non-beginners/longer-time users are indeed less likely to engage with gamification elements. They experience fewer benefits, but also don't necessarily experience disadvantages.

Another finding that points in the direction of gameful elements being

less relevant to longer-time users is the ratings given to the possible risk overreliance on gameful elements by those using the mindfulness applications most often (multiple times a week or daily (1.36, or multiple times a day (1.58), scores considerably lower than the other users gave. One could argue that this difference stems from these users being more experienced due to sheer quantity. Them experiencing less of a reliance on external motivation, suggests again that non-beginners rely more on intrinsic motivation.

Possible risk: Promoting of comparing mind

In order to find out to what extent gamification promotes a comparing mind, the respondents were asked to report how often they compare their own badges/milestones/streak to those of buddies/friends, and to what extent they think having more badges/milestones or a higher streak equals a higher quality mindfulness. The mean score respondents gave to these questions was 2.17, where past users gave a slightly higher rating (2.36) than current users (1.94). These results suggest that there is indeed a certain extent to which gameful elements promote a comparing mind, albeit not a great extent. Even though this effect doesn't seem to be too big, it shouldn't be dismissed either, since a comparing mind very directly opposes the important quality 'non-judgment' of mindfulness.

Possible risk: Distracting from formal practice

Another possible risk identified in Possible risks and benefits of gamification was that gamification elements in the app might distract the meditator during formal practice from the current moment. This was explored by asking the respondents how often they think of their streak/badges/milestones, and of sharing their current session with buddies/friends. The mean score current users gave on this is a quite low 1.75. Past users rated this at a slightly higher 2.17. For both groups, it was the lowest rated category. This suggests that users rarely get distracted by the presence of gamification elements in mindfulness applications, and that this risk is probably the least likely to be legitimate.

Possible risk: Not equally suited for all personalities

Finally, we focus on the possibility that certain personality traits might influence the way individuals experience gamification. We take a look at table 4.5.

We see that the users who said they are not sensitive to rewards at all experience most gameful elements as being less effective. Not only that, but their FFMQ score is also a lot higher than that of other users. This is an interesting correlation, although we cannot be certain which causes the others.

Those who think of themselves as being very sensitive to rewards, expectedly report the highest rating to questions related to increased engagement. However, they don't report the highest overreliance on these motivating elements. Looking at table 4.6, we can see that increased engagement has the second-highest correlation with the personality trait reward sensitivity (0.24), just after increased feeling of social support (0.35). This could mean that those sensitive to rewards experience the positive effects of motivating elements and social support stronger than the negative effects.

It is harder to find a pattern for the extravert/introvert personality trait. We can see that those who rated themselves as absolute introverts rate both the positive and the negative effects the lowest, albeit it with very small differences to the other users. We can also see that there are mainly (low) negative correlations between the possible effects of gamification and the introvert/extravert personality (table 4.6. Since absolute extravert and extravert were converted to 1 and 2 respectively, and introvert and absolute introvert to 4 and 5, this negative correlation means that those on the extravert side give higher ratings to the gameful elements on average. This data suggests that those more extravert experience gamification slightly stronger than those more introvert.

FFMQ scores by frequency of use

We can see in figure 4.10 that among current users, the FFMQ score increases with the increase in usage. Respondent who only use mindfulness applications '*sometimes*' score on average 2.72 on the FFMQ questions. This score steadily increases and tops at 3.4 for the respondents who use the mindfulness application more than once a day.

Given that the participant group who used mindfulness applications regularly in the past, but use it no more have the highest FFMQ score of all groups, one could speculate that this group used mindfulness applications to get their mindfulness practice going, and realised at some point that they don't need the app any more, continuing only their in-person practice. However, the reasons given by this group to explain why they didn't continue using mindfulness applications were mostly '*I didn't manage to incorporate it in my routine/it disappeared from my routine*' (n=4). Only two reported the expected response: '*I chose to only continue with in-person parts of my mindfulness practice*'

5.3 Reflection, Limitations, and Future Directions

In this section, I will discuss a number of points on which this research project could have been improved, what this thesis doesn't say, and where this research could be taken in the future.

FFMQ-15 In the second questionnaire, I shortened the Five-Facet Mindfulness Questionnaire from [36] to explore the mindfulness trait of participants. I selected 10 from the 39 questions to cover all five facets and to be as diverse as possible. I later learned that a shortened version of the FFMQ had already been developed. [55] This FFMQ-15 was later validated as a valid alternative for the original FFMQ-39. [56] Even though there is no direct reason to suspect the selection used in this thesis is not valid to measure trait mindfulness, I could have been more certain about the measurement of trait mindfulness if I had used the FFMQ-15.

Skewed participant pool Even though I didn't select for other requirements than participants being 18-25 years old and using or having used mindfulness applications, the second questionnaire might have attracted a skewed group of participants. As far as I see it, this comes from two things. The first is that the questionnaire required participants to reflect on their thoughts, emotions and behaviours quite a bit. Individuals who are not used to doing this might have been scared off from completing the questionnaire by the amount of self-reflection need for it. On the other hand, individuals who are not keen on self-reflection might not be attracted to mindfulness applications in the first place. This is little more than speculation, and the effect this might have had on the result is not quantifiable, yet important to note. The second way the questionnaire might have self-selected a skewed group of participants is the language used in the questionnaire. This required participants to really focus in order to understand what was asked from them, potentially scaring off those who simply didn't understand certain questions and those would have liked to casually fill in some questions.

Thus, the participant pool of this questionnaire might not have been as heterogeneous as we might have wanted. However, because this research project was not meant to give statistically significant results, this is more of a remark than a real problem.

More extensive exploration of perception of gamification of users It might have been interesting to know how the respondents think about gamification in mindfulness applications directly. Instead of asking only questions about how users feel that certain gameful elements influence certain experiences, I could have included questions asking them directly what they think of gamification, i.e., whether they would say gamification has an overall positive or negative effect on their user-experience, and whether they even like the gamification elements, apart from what the effect is they have. This would have been especially relevant in the question whether non-beginners see gamification as more of a nuisance than beginners, and how personality traits influence the perception of gamification.

Discarded questions As explained earlier, in Questionnaire 2, I discarded four questions from the questionnaire. Two of these were related to the possible risk that gamification could thwart the feeling of autonomy. The other two were meant to measure the possible risk that gamification could put too much of a focus on external goals instead of letting the meditator rely on intrinsic motivation. No other questions were put in the questionnaire to cover these two possible risks, and hence this thesis can't make us any wiser about them.

Personalisation When looking at the found gameful elements in the mindfulness applications in table 4.1, we can see that in total 6 different types of gameful elements were found. Badges or achievements, Customisation, Levels of progress feedback, Social comparison, and Social networking were all included in the second questionnaire. However, no existing research was found and/or included in the reflection in Possible risks and benefits of gamification on Personalisation, and hence no questions were included in the second questionnaire to try and measure the effect of this type of gamification in mindfulness applications. Unfortunately, we are thus none the wiser about this after this research project.

Lack of focus on aspects of a high-quality mindfulness practice
When designing the second questionnaire, I focused mainly on the identified risks and benefits. However, this resulted in a lack of attention to the identified aspects of a high-quality mindfulness practice, making it more difficult to link the results of this questionnaire to these separate aspects.

Future directions

Given the results of this research project, it would be interesting to explore more in-depth how users experience gamification in mindfulness applications. For example, by interviewing users of mindfulness applications, one could more extensively explore things such as what kinds of Customisation are most important to feeling more in control of their mindfulness journey.

The results of this thesis could well be used to rethink the design of gamification in mindfulness applications. For example, by creating multiple prototypes and exploring different options of gamification of the same system. This would allow for more direct measurements of the effects of different types of gamification on the quality and experience of the mindfulness practice of users.

Chapter 6

Conclusions

In this thesis, we asked ourselves the following question:

> **How does the gamification of the digital mindfulness practice influence the quality of this practice?**

We aimed to answer this question by exploring trends in how 18-25 years old use mindfulness applications and how they react to gameful elements in these apps.

There was no data available on the usage patterns of mindfulness applications, let alone by 18-25 years old, so we first set out to find out which mindfulness applications are used by the target audience. Due to the small number of participants of the questionnaire that aimed to explore this, we can't provide a very broad overview of these usage patterns, but we could see that mainly the app Headspace, followed by Calm, was used the most by our participants. Furthermore, Insight Timer, Tide and VGZ Mindfulness Coach were also used by multiple participants.

The next step was to find out what gamification in mindfulness applications looks like. The above-mentioned applications were analysed using an existing taxonomy, that was developed to use for mental health applications. The taxonomy identified 18 possible gameful elements, of which the following five were found at least once in the mindfulness applications: (1) Badges or achievements, (2) Customisation, (3) Levels or progress feedback, (4) Personalisation, (5) Social comparison, and (6) Social networking. All six were found in Headspace, five were found in Insight Timer (no Social comparison), three were found in both Calm and Tide (no Badges or achievements, Social comparison and Social networking), and none were found in VGZ Mindfulness Coach.

In order to relate the use of gamification to the quality of mindfulness, it was necessary to know what a high-quality mindfulness looks like. Given that there isn't even real consensus on the meaning of mindfulness, there definitely wasn't a clear list of requirements for high-quality mindfulness.

Therefore, we first explored the different viewpoints on mindfulness. We found that the most important categories are 'formal' practice, i.e., intentionally taking time out of your day to meditate, cultivating a 'state' mindfulness, and 'informal' mindfulness practice, i.e., nurturing a mindful way of being in every moment of the day, cultivating a 'trait' mindfulness. Characteristics of one's demeanour during formal practice found to be important to a high-quality state mindfulness are (1) Curiosity, (2) Non-judgment, (3) Acceptance, and (4) Attention. Characteristics found to be important to trait mindfulness are (1) Nonreacting, (2) Observing, (3) Acting with Awareness, (4) Describing, and (5) Non-judging. We decided to include both state and trait mindfulness in our further research.

Because there is so little existing research on gamification of mindfulness, there was no clear overview of the possible risks and benefits gamification in mindfulness applications pose towards the quality of the mindfulness. Hence, we dove into existing literature of related research topics to draft such an overview ourselves. Possible benefits mainly had to do with increased engagement, either directly, by motivating users to return to the app to keep their streak going for example, or indirectly, for example by increasing a feeling of autonomy (Customisation) or social support (Social networking), which both help to create a more appealing 'environment' to return to. Additionally, gentle notifications throughout the day to remind the user to turn one's focus to the present moment could help bridge the gap between state and trait mindfulness. Possible risks mainly come in the form of distracting the user during formal practice, promoting an overreliance on motivating elements and a comparing mind when suggesting (implicitly) that e.g. having a higher streak equated to having a higher quality mindfulness. Additionally, indications were found that the user's experience level, reward sensitivity and introversion/extraversion influence how gamification is perceived.

The next step was to set out a second, main questionnaire to explore these found possible risks and benefits. We found that both the suspected benefits and risks are grounded in truth. For example, motivating elements seem to indeed improve the engagement with the system, but that these elements also indeed promote an overreliance on extrinsic motivation. The gameful element with the seemingly most positive effect is that of social networking, helping to create a safe container for the users. Additionally, setting up customised reminders throughout the day to bring the individual back to the present moment seem to be promising in bridging the gap between formal and informal practice. Indications were found that non-beginners engage less with gamification elements, suggesting that gamification is more relevant for beginners, functioning as a form of training wheels. A non-convincing correlation was found between the quality of mindfulness and the engagement with gameful elements; the higher the engagement with gamification (both positively and negatively), the lower the quality of

mindfulness of the individual, possibly suggesting that gamification elements interfere with mindfulness overall.

Previous literature called out for more research to substantiate the motivation to add gameful elements to non-game systems. This thesis answers to this request by exploring the small scope of gamification in mindfulness applications. Based on the results from the two questionnaires and the non-systematic literature reviews performed in this thesis, it can be concluded that there are both benefits and risks associated with using gamification in mindfulness applications. Designers of mindfulness applications should consider these risks and benefits closely and use gameful elements accordingly.

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Appendix A

Questionnaire 1

Below, you will find the questions of the first questionnaire. The questionnaire itself was set out in an online environment, this is a mere textual representation.

Usage of Mindfulness Applications - Questionnaire 1/2

<u>Introduction</u>
Thank you for opening this questionnaire!

This questionnaire is part of the bachelor thesis for the bachelor Computing Science at the Radboud University, performed by me (Tim van Alten, tim.vanalten@ru.nl) with supervision of Luca Consoli (l.consoli@science.ru.nl).

Purpose
This questionnaire is part of a study that investigates the relation between the gamification (e.g. addition of streaks, leaderboards and points) of digital mindfulness applications and the quality of this practice. This questionnaire is the first of two questionnaires, and aims to collect some basic information about the usage of mindfulness applications amongst the target population (18-25 year olds). The second questionnaire will focus more on the (experience of) gamification in mindfulness applications.

What can you expect
This questionnaire consists of 4 questions, and will take you approximately 1-2 minutes to complete.

Voluntary participation
Participation in this research is completely voluntary. In case you don't want to continue you can simply close the survey without giving any reason. Your data will only be stored and used if you have submitted the survey.

Data collection and storage
After the last question, the questionnaire offers the option to leave your email address, for the purpose of being contacted for the second questionnaire. This is not obligatory. Otherwise, no personal identifying information will be collected. The results of this survey will purely be used for this study.

In case you have any questions about the study, please contact me at tim.vanalten@ru.nl and/or my supervisor at l.consoli@science.ru.nl

Have you read and understood the above information, do you agree to participate, are you at least 18 years old and at most 25 years old and have you used a mindfulness application at least once?

○ Yes *Sends to next section*

○ No *Sends to last question*

Usage of Mindfulness Applications

Which mindfulness application(s) have you ever used?
Note: if you have never used mindfulness applications, you cannot participate in this research. *Names and logos may differ slightly depending on your platform *Multiple options possible, logos left out here*

☐ Headspace: Mindful Meditation

☐ Calm - Meditate, Sleep, Relax

☐ Relax Meditation: Guided Mindfulness Meditations

☐ Insight Timer - Wellbeing App

☐ Digipill

☐ Ten Percent Happier - Meditation & Sleep

☐ Simple Habit: Meditation App

☐ Omvana - Meditation for Performance & Flow States

☐ The Mindfulness App: relax, calm, focus and sleep

☐ Meditation Timer

☐ Breethe - Meditation & Sleep

☐ Tide - Sleep & Meditation

☐ Smiling Mind

☐ Other, namely:

How often have you used/do you use these mindfulness applications?

○ Used it once or twice in the past

○ Used it regularly in the past

○ Use it sometimes (less than once a week)

○ Use it once or twice a week

○ Use it multiple times a week/daily

○ Use it multiple times a day

What is the main reason you started using the mindfulness application(s)?
Select at most two answers

☐ Curiosity

☐ To relax/reduce stress

☐ To improve sleep

☐ To improve mental health

☐ To improve focus

☐ To complement in-person parts of my mindfulness practice

☐ To reduce physical pain

☐ To live more mindfully

What is the main reason you continue(d) using the mindfulness application(s)?
Select at most two answers

☐ Curiosity

☐ To relax/reduce stress

☐ To improve sleep

☐ To improve mental health

☐ To improve focus

☐ To complement in-person parts of my mindfulness practice

☐ To reduce physical pain

☐ To live more mindfully

Completion

There will be a second questionnaire in a couple of weeks. If you want to participate in the second questionnaire as well, and want to be contacted directly for this, please fill in your email address below. The email address will only be used to contact you once for the second questionnaire. The second questionnaire will also be send out via other platforms. *Not required to answer, sends to 'submit form'*

You are either not 18-25 years old, never used a mindfulness application or you don't agree with participation. Unfortunately, you cannot take part in this research. Thank you for the interest! *Sends to 'submit form'*

Appendix B

Taxonomy Gamification

Below, an overview of the applied taxonomy on the most-used MBAs can be found. The gameful elements, and the definitions are directly taken from the taxonomy as defined by [17]. Only gameful elements that were found in at least one MBA are included.

Gameful elemenent	Definition of gameful element	MBA	Explanation
Badges or achievement	Being awarded permanent visual recognition, for example via badges, certificates and achievements, by the system in response to accomplishing meaningful goals inside the system.	Headspace	Badges for certain streaks[1]
		Insight Timer	Milestones for non-consecutive and consecutive days meditated
Customisation	Being able to customize avatars and other types of representation (of the self or of the player character), or other aspects of the user experience, either freely or through spending in-game currency or real currency.	Headspace	Different types of notifications and reminders
		Calm	Customisable notifications, choose to (not) show streaks
		Insight Timer	Different types of notifications and reminders. Option to only show meditation timer when opening app
		Tide	Customise reminders
Levels or progress feedback	User is given an indication of their progress in a task and in the overall content of the system, and how far they have to go to succeed in or finish the task and reach the next milestone	Headspace	Statistics available on current streak, cumulative meditation time and average duration of session
		Calm	Statistics available on current and longest streak, cumulative meditation time and sessions
		Insight Timer	Statistics available on current and longest streak, history of sessions, graph of cumulative time meditated
		Tide	Statistics available on current streak and cumulative meditation/sleep/focus time

Gameful elemenent	Definition of gameful element	MBA	Explanation
Personalisation	The system learns about you either by asking you directly or by analyzing your behavior in the system, and adapts what and how it presents to you to suit you (e.g. adaptive difficulty, using real-time location data). As opposed to 'Customization', this is driven by the system	Headspace	Recommended meditations based on user preferences and history
		Calm	Recommended meditations based on user preferences and history
		Insight Timer	Recommended meditations based on user preferences and history
		Tide	Recommended meditations based on user preferences and history
Social comparison	The system allows users to see other users' actions, and to show off their own achievements, progress and/or status to other users.	Headspace	User can see when buddies last meditated
Social networking	System or app allows users to make connections with each other, perhaps facilitating this by matching similar users, and to express or act upon these connections, for example via gifting, or communicating via comments, messages, stickers, etc.	Headspace	User can send encouraging messages to buddies
		Insight Timer	Friends: chat, see achievements, recent meditations and reviews of guided meditations, groups: chats and shared feed, see who are currently meditating

Table B.1: Applied gamification taxonomy

Appendix C

Questionnaire 2

Below, you will find the questions of the second questionnaire. The questionnaire itself was set out in an online environment, this is a mere textual representation.

Gamification in Mindfulness

<u>Introduction</u>
Thank you for opening this questionnaire!

This questionnaire is part of the bachelor thesis for the bachelor Computing Science at the Radboud University, performed by me (Tim van Alten, tim.vanalten@ru.nl) with supervision of Luca Consoli (l.consoli@science.ru.nl).

<u>Purpose</u>
This questionnaire is part of a study that investigates the relation between the gamification (e.g. addition of streaks, leaderboards and points) of digital mindfulness applications and the quality of this practice. This questionnaire is the second of two questionnaires, and aims to collect more in-depth information on the (perceived) benefits and drawbacks from using gamification in mindfulness applications. It is not necessary to have filled in the first questionnaire to participate in this second questionnaire.

<u>What can you expect</u>
Filling in this questionnaire will take you approximately 8-10 minutes.

<u>Voluntary participation</u>
Participation in this research is completely voluntary. In case you don't want to continue you can simply close the survey without giving any reason. Your data will only be stored and used if you have submitted the survey.

Data collection and storage
This questionnaire is completely anonymous. No personal identifying information will be collected. The results of this survey will solely be used for this study.

In case you have any questions about the study, please contact me at tim.vanalten@ru.nl and/or my supervisor at l.consoli@science.ru.nl

Have you read and understood the above information, do you agree to participate, are you at least 18 years old and at most 25 years old and have you used a mindfulness application at least a few times?

○ Yes *Sends to next section*

○ No *Sends to last question*

Usage of Mindfulness Applications - Part 1
On this page, you will be asked why you initially started using a mindfulness application and whether or not you still use mindfulness applications.
What is the main reason you started using (a) mindfulness application(s)?
Select at most two answers

☐ Curiosity

☐ To relax/reduce stress

☐ To improve sleep

☐ To improve mental health

☐ To improve focus

☐ To complement in-person parts of my mindfulness practice

☐ To reduce physical pain

☐ To live more mindfully

Do you currently use at least one mindfulness application?

○ No. I used (a) mindfulness application(s) a couple of times in the past *Sends to next section*

○ No. I used (a) mindfulness application(s) regularly in the past *Sends to next section*

○ No. I used (a) mindfulness application(s) very irregularly in the past (e.g., seven days in a row, then not for three months, and then a couple of days in a row again) *Sends to next section*

○ Yes, sometimes (less than once a week) *Sends to fourth section (skips the next)*

○ Yes, once or twice a week *Sends to fourth section (skips the next)*

○ Yes, multiple times a week or daily *Sends to fourth section (skips the next)*

○ Yes, multiple times a day *Sends to fourth section (skips the next)*

○ Yes, but very irregularly (e.g., seven days in a row, then not for three months, and then a couple of days in a row again) *Sends to fourth section (skips the next)*

Usage of Mindfulness Applications - Part 2

You indicated you don't use (a) mindfulness application(s) anymore. On this page you will find some questions about the app(s) you used.

When did you first start using (a) mindfulness application(s)

If you have used multiple apps, please indicate when you started using the first one.

○ 5+ years ago

○ 2-5 years ago

○ 1-2 year ago

○ Less than a year ago

○ Less than three months ago

When did you last use (a) mindfulness application(s)?

○ 5+ years ago

○ 2-5 years ago

○ 1-2 year ago

○ Less than a year ago

○ Less than three months ago

Why did you not continue using mindfulness applications?

○ I didn't manage to incorporate it in my routine/it disappeared from my routine

○ I lost interest in mindfulness/meditation

○ I chose to only continue with in-person parts of my mindfulness practice

○ Other, namely:

Which mindfulness application(s) did you use?
*Names and logos may differ slightly depending on your platform *logos left out here*

☐ Headspace: Mindful Meditation

☐ Calm - Meditate, Sleep, Relax

☐ Insight Timer - Wellbeing App

☐ Tide - Sleep & Meditation

☐ VGZ Mindfulness Coach

☐ Other, namely:

Why did you use the application you selected above?
If you used multiple apps, please answer this question with the app you used most in mind

○ It got recommended by friends/family

○ It got recommended by my doctor, therapist or other professional

○ Advertisement

○ I selected it randomly from the app store

○ Chose it after reading reviews

○ Other, namely:

Sends to fifth section (skips the next)

Usage of Mindfulness Applications - Part 2
You indicated you still use (a) mindfulness application(s). On this page you will find some questions about your mindfulness practice.
When did you first start using (a) mindfulness application(s)
If you started with a different app than you currently use, please indicate when you started using the first one.

○ 5+ years ago

○ 2-5 years ago

○ 1-2 year ago

○ Less than a year ago

○ Less than three months ago

What is the main reason you continue using the mindfulness application(s)?
Select at most two answers

☐ Curiosity

☐ To relax/reduce stress

☐ To improve sleep

☐ To improve mental health

☐ To improve focus

☐ To complement in-person parts of my mindfulness practice

☐ To reduce physical pain

☐ To live more mindfully

Which mindfulness application(s) d you use?
*Names and logos may differ slightly depending on your platform *logos left out here*

☐ Headspace: Mindful Meditation

☐ Calm - Meditate, Sleep, Relax

☐ Insight Timer - Wellbeing App

☐ Tide - Sleep & Meditation

☐ VGZ Mindfulness Coach

☐ Other, namely:

Why do you use the application you selected above?
If you use multiple apps, please answer this question with the app you use most in mind

○ It got recommended by friends/family

○ It got recommended by my doctor, therapist or other professional

○ Advertisement

○ I selected it randomly from the app store

○ Chose it after reading reviews

○ Other, namely:

Personal characteristics
There are some indications that certain personal characteristics influence the way people perceive gamification. Therefore, I would like to ask you some questions about these personality traits.

Would you describe yourself as an introvert or an extravert?
Here, being an extravert would mean you get energy from being around people, while being an introvert means your energy gets drained from being around people, and you charge when you are alone.

	1	2	3	4	5	
Absolute extravert	○	○	○	○	○	Absolute introvert

Would you describe describe yourself as being sensitive to rewards? In other words, do you thrive when there are external stimuli to motivate you?
E.g., are you more motivated to perform a task if you know there is a reward waiting for you upon completion?

	1	2	3	4	5	
Not sensitive to rewards at all	○	○	○	○	○	Very sensitive to rewards

Please rate each of the following statements with the number that best describes your own opinion of what is generally true for you

	Never or very rarely true	Rarely true	Some-times true	Often true	Very often or always true
When I do things, my mind wanders off and I'm easily distracted.	○	○	○	○	○
I can easily put my beliefs, opinions, and expectations into words.	○	○	○	○	○
I tell myself I shouldn't be feeling the way I'm feeling	○	○	○	○	○
I notice how foods and drinks affect my thoughts, bodily sensations, and emotions	○	○	○	○	○
I pay attention to sensations, such as the wind in my hair or sun on my face.	○	○	○	○	○
In difficult situations, I can pause without immediately reacting	○	○	○	○	○
When I have a sensation in my body, it's difficult for me to describe it because I can't find the right words.	○	○	○	○	○
It seems I am "running on automatic" without much awareness of what I'm doing.	○	○	○	○	○
When I have distressing thoughts or images, I feel calm soon after	○	○	○	○	○
When I have distressing thoughts or images, I judge myself as good or bad depending what the thought or image is about.	○	○	○	○	○

Perception of gamification

In this (last) part of the questionnaire, you will see a list of statements on experiences/thoughts you may or may not have had regarding gamification in mindfulness applications. Please indicate for each statement how often or to what degree you agree with it.

Important: If you have seen the gameful element described, but have never interacted with it the way described in the statement, please select 'Never' or 'Strongly disagree'. If you have never seen the gameful element, please select 'N/A'

If you use multiple apps, you may keep all in mind. For example, if you have seen badges in one app, but can share progress with buddies in another, you can answer questions about badges with the first app in mind, and questions about sharing progress with the second in mind. If the experiences of one app are contradictory for a statement, answer with the app that is most important to you in mind.

Depending on the app(s) you use, you may recognise none, some, or all of the gameful elements described. Even if you recognise none of the gameful elements, the answers to the other questions in this questionnaire are very valuable. You can simply answer 'N/A' to all statements.

For the following statements, please indicate how often you agree with it.
If you haven't done so yet, please read the instructions above.

	Never or very rarely true	Rarely true	Some-times true	Often true	Very often or always true	N/A
I get excited when earning a new badge	○	○	○	○	○	○
I find it easier to return to the app when I am close to getting a new badge	○	○	○	○	○	○
I know when I will get a new badge without checking	○	○	○	○	○	○
I only return to the app to keep my streak intact	○	○	○	○	○	○
I get excited when reaching a new milestone in my streak	○	○	○	○	○	○
I find it easier to return to the app when I am close to a milestone in my streak	○	○	○	○	○	○
I know on what day of my streak I am without checking	○	○	○	○	○	○
I get excited when reaching a new milestone in my total/cumulative meditation time	○	○	○	○	○	○
I find it easier to return to the app when I am close to a new milestone in my total/cumulattive meditation time	○	○	○	○	○	○
I know my total/cumulative meditation time without checking	○	○	○	○	○	○
I do longer meditation sessions to keep the average meditation time up	○	○	○	○	○	○
I get motivated to meditate when seeing my friend/buddy also meditated recently	○	○	○	○	○	○

I get motivated to meditate when reading stories/experiences from other users on the shared feed	○	○	○	○	○	○
I get motivated to meditate when buddies/friends message me	○	○	○	○	○	○
I get motivated to do a specific guided meditation when I see a positive review from a buddy/friend	○	○	○	○	○	○
I feel more in control of my mindfulness journey when I can customise the way the app presents the meditation sessions to me	○	○	○	○	○	○
I feel more in control of my mindfulness journey when I can customise the way I (don't) get reminded to meditate	○	○	○	○	○	○
I feel more in control of my mindfulness journey when I can customise the way I (don't) get to see statistics of my meditation sessions	○	○	○	○	○	○
I feel less alone in my mindfulness practice when reading stories/experiences from other users on the shared feed	○	○	○	○	○	○
I feel less alone in my mindfulness practice when buddies/friends message me	○	○	○	○	○	○
I find myself comparing my streak to the streak of my buddy/friend	○	○	○	○	○	○
I find myself comparing my badges/milestones to the badges/milestones of my buddy/friend	○	○	○	○	○	○
I find myself returning to the app to earn new badges/milestones	○	○	○	○	○	○
I find myself returning to the app just to save my streak	○	○	○	○	○	○
During a meditation session, I think of my streak	○	○	○	○	○	○
During a meditation session, I think of my badges/milestones	○	○	○	○	○	○
During a meditation session, I think of sharing the performed session with buddies/friends	○	○	○	○	○	○

For the following statements, please indicate to what degree you agree with it.

	Strongly disagree	Disagree	Neutral/ undecided	Agree	Strongly agree	N/A
I feel more mindful throughout the day because of regular reminders to focus on the present-moment	○	○	○	○	○	○
I set up reminders to focus on the present-moment on specific times during the day, for example during the time I generally eat my dinner	○	○	○	○	○	○
I would use the app less if there were no badges/milestones to be reached	○	○	○	○	○	○
I would use the app less if there was no streak	○	○	○	○	○	○
I would use the app less if I could not connect to buddies/friends	○	○	○	○	○	○
I would stop using the app altogether if there were no badges/milestones to be reached	○	○	○	○	○	○
I would stop using the app altogether if there was no streak	○	○	○	○	○	○
I would stop using the app altogether if I could not connect to buddies/friends	○	○	○	○	○	○
I feel more in control of my mindfulness journey because I can work towards new badges/milestones	○	○	○	○	○	○
I feel more in control of my mindfulness journey because I can share my progress with buddies/friends	○	○	○	○	○	○
The more badges/milestones I have, the higher the quality of my mindfulness will be	○	○	○	○	○	○
The higher my streak, the higher the quality of my mindfulness will be	○	○	○	○	○	○

Completion

This was the last question. Thank you for your participation! In case you have any questions about the study, please contact me at tim.vanalten@ru.nl and/or my supervisor at l.consoli@science.ru.nl

Sends to 'submit form'

Completion

You are either not 18-25 years old, never used a mindfulness application or you don't agree with participation

Unfortunately, you cannot take part in this research. Thank you for the interest! In case you have any questions about the study, please contact me at tim.vanalten@ru.nl and/or my supervisor at l.consoli@science.ru.nl

Sends to 'submit form'