Understanding the Experience of Situated Mindfulness Through a Mobile App That Prompts Self-reflection and Directs Non-reactivity

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Abstract. This paper explores how mobile technology may be able to activate and support mindfulness states while users are situated in everyday life. Interviews with users on the use of a mobile app that was designed to prompt self-reflection and direct non-reactivity, suggest that activating situated mindfulness, may lead to differences in the kind of self-reflection individuals engage in. In addition, a situated approach may alter the way in which we engage in being non-judgmental and non-reactive, bringing the focus to the contents of mental events rather than the process. This paper concludes with implications for the design of mobile technology seeking to prompt and support mindfulness states while situated in everyday life.

Keywords: Mindfulness · Situated cognition · Self-reflection · Self-awareness · Emotional health · Persuasive design · Mobile learning

1 Introduction

In the past decade, mainstream interest in mindfulness has fueled a growth in research in the psychology, mental health, and contemplative studies fields. The growing interest in mindfulness has led to an increase in software applications seeking to support the cultivation of mindfulness. Despite the origins of mindfulness that embed the practice within the context of ethical action and compassion [1], Western psychology commonly defines mindfulness mainly as consisting of the two components of attentional control and non-reactivity [2] with more recent research teasing out these two components more distinctly [3].

Currently there is still very limited empirical research on the potential role technology can play in the cultivation of mindfulness, specifically in prompting attentional shifts that are self-reflective in nature, and supporting non-reactivity [4]. Yet it has been argued that, for a variety of reasons, mobile technology can be particularly effective toward the goal of cultivating mindfulness [4]. From the research that has emerged, the majority focuses on supporting meditation practices with some research also exploring the use of persuasive design techniques to promote tracking. For example, mobile technology has been explored as a way to support self-monitoring [5, 6], and deliver audio-guided meditation and psychoeducation [7, 8]. Our initial analysis of the landscape yielded common design approaches

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currently taken such as directed instruction, interactive instruction, prompted engagement, social engagement, and tracking and aggregation. Remaining unexplored is the how mobile technology may provide an opportunity to situate mindfulness practices in the authentic context of everyday life. The idea that one can be prompted to enter into mindfulness states with the support of a mobile app is riddled with both technical and contemplative issues. While the technical focuses on usability aspects of interrupting everyday life with bothersome notifications, the contemplative issues highlight the issue with operationalizing – and in some cases corrupting – certain phenomenological aspects and traditional conceptualizations of mindfulness.

Using a mobile app, SIMA (Situated Interactive Mindfulness App), this paper explores how prompting self-reflection and supporting non-reactivity is experienced when situated in users' everyday life. Through a qualitative research approach we explore the question of how a mindfulness state is activated and supported in everyday life using a mobile app, and how the self-reflective and non-reactive aspects of mindfulness are experienced. Our findings suggest that activating a mindfulness state in individuals may require designing for the support of reflection-in-action rather than reflection-on-action. In addition, designing for cultivation of mindfulness through a situated approach may alter the way in which non-reactivity can be supported, bringing the focus more to the contents of mental events rather than the process.

2 Situated Mindfulness: Theoretical Framework

Mindfulness is commonly defined as consisting of two overarching components of present-moment awareness and non-judgment [9]. Historically, the origins of mindfulness stem from Buddhist traditions whereby mindfulness was seen as an ethical practice which was thought not just to reduce clinging and attachment (core parts of human suffering), but was also thought to be essential to being a compassionate and an enlightened being [1]. In this section we discuss the theoretical foundations on which SIMA was designed. First we define mindfulness as a state and why self-reflection and non-reactivity are related. We then explore the concept of situated mindfulness, which combines the idea of being in a mindfulness state, and being situated in everyday contexts that influence the thoughts and emotions brought in and out of attention during a mindfulness state (e.g., thoughts while at your office desk at work, interacting with friends, etc.).

2.1 Mindfulness as a State

There are two common approaches taken in operationalizing mindfulness. The most common is a trait-based approach where instruments such as the FFMQ (Five Facet Mindfulness Questionnaire) seek to capture self-reported behaviors that point to a dispositional tendency that can also change with prolonged mindfulness training [10–13]. However, another approach is to view mindfulness as a temporary state that can be induced by an individual with effort [14, 15]. Theoretically these two approaches may be related in that continued mindfulness state induction and maintenance may lead to

changes in mindfulness traits. Our focus in this study was on mindfulness as a state, however current measures such as the TMS (Toronto Mindfulness Scale) [16], were developed around meditation practices not non-meditation practices, which was our design focus. We sought to tease out the two factors curiosity and decentering that underlie the TMS measure to inform our own design and qualitative data collection.

Curiosity. The curiosity factor is defined as reflecting an attitude of wanting to learn more about one's own experiences. The authors of the TMS measure argue that empirical derivation of the curiosity factor also encapsulates the attentional self-regulation component suggested in Bishop's definition – present-moment awareness – in that one cannot be curious, open or accepting of experiences one has not brought into their attention [16]. Research has shown that non-secular meditation approaches that allow for taking an investigative interest in mental events (e.g., Mindfulness-Based Stress Reduction) have the tendency to lead to improvements in curiosity as compared to meditation approaches that discourage investigative interests in mental events (e.g., Shambala meditation) [16]. In our design, the key to cultivating curiosity then is the meta-cognitive process of self-reflection where one observes internal events such as thoughts and emotions, and does not inhibit investigative interest in such mental events.

Decentering. Decentering is the second factor in the mindfulness state construct, and is defined as reflecting a shift from identifying personally with thoughts and feelings to relating to one's experience of a wider field of awareness [17]. In other words, decentering is about seeing one's thoughts and feelings as passing mental events in the mind rather than reflections of reality. The notion is that by observing one's mental events, there is the ability to not cling or attach to one event, but focus instead on the process of the ongoing flow of mental events. At the heart of such decentering is an attentional shift between mental events. For example, in meditation practice, such as Vipassana, one focuses on breathing while directing attention back and forth from an ongoing flow of mental events, and breathing. In the shift, there is an "un-clinging" that occurs, decentering one's mental state of self-reflection. Some debate the term decentering in that it suggests a top-down conceptual processing whereby the mind focuses on the content of mental events rather than a bottom-up approach that remains on a phenomenological level of awareness [18]. For instance, in Buddhist Vipassana traditions the idea is to eventually experience mental events within the phenomenological field with no effort required to actively regulate or reappraise what is experienced rather than actively work to regulate mental events [14]. Key to cultivating decentering then is supporting a degree of attentional shifting towards and away from mental events (i.e., thoughts and feelings).

2.2 Situated Mindfulness

So how do the factors of curiosity and decentering that comprise the mindfulness state construct relate to being situated in everyday life? Our study seeks to posit this idea of situated mindfulness – a mindfulness state that makes use of situated contexts external to one's mental events (e.g., being at work before a big presentation, or coming home

after a stressful day). Situated mindfulness includes such contexts as part of the attentional shifting process, incorporating such shifts under the curiosity and decentering factors. For example, one would be aware not just of being happy, but being happy because one is about to eat. The positing of situated mindfulness presents challenges, not just in the design of an intervention that can accomplish such experiences, but also in possibly distorting initial conceptions of what it means to be mindful.

The value of incorporating situational context into how we understand mindfulness states stems from the concept of situated cognition, which posits that the situations that comprise our everyday life (i.e. authentic contexts) deeply influences how we make meaning [19]. The idea that that knowledge is contextualized in an experiential framework is relevant to mindfulness states in that the investigative interests at the core of curiosity may or may not change in ways that are beneficial when including the situational contexts that may have influenced such mental events. The incorporation of situational context in self-reflections may change how we experience curiosity within a mindfulness state. Furthermore, including situational contexts in how we shift our attention during decentering may change how we experience the non-reactivity that characterizes a decentered state.

Yet there are challenges in conceptualizing mindfulness as explicitly situated. Primarily there is the technical challenge of managing such attentional shifts between internal mental events, and external situational influences. Also there is the question of how this may distort, either beneficially or negatively, our conceptions of "being mindful." In other words, it is not clear how we may experience mindfulness states, when there are explicit attempts to include in our self-reflection and attentional shifting, the influence of situational contexts on our internal mental events.

3 Systems Design: Situated Interactive Mindfulness App (SIMA)

SIMA (Situated Interactive Mindfulness Application) is a mobile phone application that uses prompted self-reflection and directed non-reactivity as core design approaches to the curiosity and decentering factors of mindfulness states.

The experience begins when the user first enrolls in the ten-day workout that consists of a set number of mindfulness activities for them to engage in daily. Each day, the user is prompted to commit to engaging in the activities for the day (Fig. 1, left). At this point the user can choose to not accept the daily commitment, and instead continue the workout starting the following day. From our usability studies we found that the integration of a daily commitment decreased perceived inflexibility of the system when variations from day-to-day occurred, and increased engagement.

Once a user decides to commit for the day, they are prompted a maximum of three times a day to "check-in" (Fig. 1, right), in the form of a push notification. In our preliminary usability studies, three times a day seemed to be the number of check-ins that did not overwhelm or annoy users, but still allowed us to capture enough variation within the day in terms of situational contexts. When creating an account, the user initially sets the time they start their day, and the system automatically spaces out the check-ins based on 14 h of wake time.

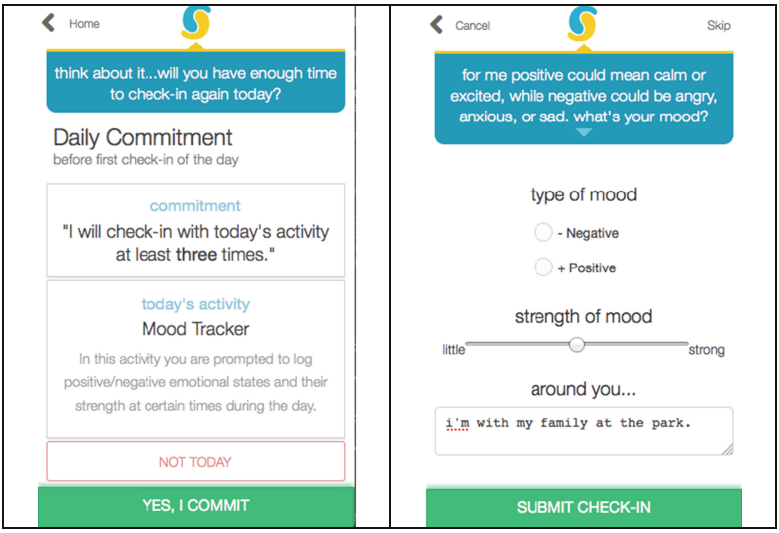

Fig. 1. Screenshots of SIMA making a daily commitment (left), and receiving feedback (right)

The workout for this study prompted self-reflection using two different kinds of activity check-ins, a "general" check-in activity and a "specific" check-in activity. In general check-ins, users are prompted to direct their attention to their current mood or thoughts, and take note of the situational context (e.g., Fig. 1, right). In specific check-ins users are prompted to contrast their current mental events with a specified one (e.g., gratitude). The five different activities used in the workout are listed in Table 1, by day. For example, in days 3 and 4, users received the gratitude check-in where they are prompted to track (type in) a sense of gratitude and make note of the situational context. In all check-ins users engage in a form of tracking and are then taken to a directed non-reactivity screen where users are instructed to not react to the mental event they are attending to (i.e., analyze or seek to change it).

Table 1. List of workout activities by day

Day(s)	Type	Activity name	User input
1–2	General	Thought tracker	Short description of thought and context
3–4	Specific	Gratitude	Sense of gratitude and context
5–6	General	Mood tracker	Magnitude and valance of mood and context
7–8	Specific	Compassion	Sense of compassion and context
9	General	Thought tracker	Short description of thought and context
10	Specific	Negative self-talk	Sense of self-criticism and context

We engaged in several interactions of design and usability studies to reduce confusion with the check-in process and directions. We settled on thought and mood tracking as the general check-ins in that they correspond to the typical mental events in a mindfulness state. Deciding on the specific check-ins was more challenging in that there are

a multitude of contexts that could be focused on. We focused on gratitude, compassion, and negative self-talk in that these contexts were the least geo-location and temporal restrictive and are the most common contexts used in mindfulness-based therapeutic approaches.

This design foregrounds situated mindfulness and draws on theory in several ways. First, users are prompted to direct their attention in specific ways throughout their day and to include their situated surroundings as part of the focus of their attention. Second, users are directed to not-react to mental events.

3.1 Methods

This qualitative study relied on semi-structured interviews with a sample of seven young adults ages 18–30 to explore the experiential ramifications of our system design; quantitative assessments of mindfulness outcomes and in-depth analysis of behavior logs are left to future work. Two of the participants were male, and all participants were recruited in New York City via flyers, social media, and snowball sampling. To participate, individuals must have not engaged in more than 5 h of total meditation in the past year, but had engaged in at least one hour of mindfulness meditation in the past year. While we did not use prior meditation experiences as a basis for comparison, we felt those that had previously experienced mindfulness meditation may be more readily able to speak to amorphous concepts of present-moment awareness and mind wandering that overlap with curiosity and decentering.

Participants engaged with SIMA over ten days using their own mobile phone and then completed an interview at the end of the study. The study was designed as 10 days based on our experience in usability studies that showed there was familiarity with the mechanic of responding to prompts after two days, and engagement fatigue after 10 days, given our relatively meager compensation of a $10 Amazon gift card. The focus of the study was on how different forms of prompted self-reflection and directed non-reactivity designs influence how curiosity and decentering are experienced.

The semi-structured interview at the end of the study focused on five aspects of the mindfulness experience: prompted self-reflection, curiosity, non-reactivity, decentering, and the situated nature of the interactions with the mobile app. Specifically, the interview questions adopted many concepts from the Toronto Mindfulness Scale (TMS) quantitative instrument that, while focuses on meditation-based approached, were expanded to meet our needs to understand curiosity and decentering aspects of a non-meditation-based approach, and the situated prompted self-reflection and directed non-reactivity design approaches to those factors. The TMS itself was not integrated in that the TMS is more relevant after each meditation session rather than in aggregate, and has been validated for meditation-based approaches. Perhaps future work can address this limitation. We analyzed interviews from all of the participants using thematic analysis [20]. The audio recordings were transcribed and analyzed for emergent themes. Five of the seven participants engaged in a second interview after our analysis to tease out additional information on their experience. The next section presents the themes that emerged and are relevant to guiding the design of situated mindfulness interventions.

4 Results

This section focuses on how the design approaches of self-reflection and directed non-reactivity impacted users' experiences of using SIMA to activate and support a mindfulness state while situated in their day-to-day life.

4.1 Prompted Self-reflection on Curiosity Factor of Mindfulness State

The first overarching theme that emerged was around self-reflection itself. There was strong evidence that SIMA's prompted engagement approach through the use of check-ins (i.e., notifications) engaged participants in self-reflection. Every single participant recalled moments where the prompts triggered an attentional shift to current mental events. Through phrases such as "I thought to myself", "I noticed I felt", it was clear that the check-ins throughout the day did elicit self-reflection in participants. For instance, one participant Randy shared that, "I got the notification and then tracked my mood. I thought to myself, what am I feeling and then the thoughts that seemed to be associated with that mood." Another user Sharon described how the mood tracker activity, "let me checkin with myself." For Jay labeling his mood required momentary self-reflection where he would, "see if the labels made sense, and if I was really feeling what I thought I was feeling."

The implications here are that push notifications, directing users to explicitly shift attention to their current mental events, is a promising design approach. However, with that said, there were variations in the kinds of self-reflection that were experienced, and aspects of the usability design that influenced the how self-reflection was experienced or engaged with.

Self-reflection as Retrospective and In-Action. Almost all of the participants made a distinction between retrospective and in-action reflection when sharing their experience with the prompted self-reflection approach taken by SIMA. In retrospective self-reflection the focus was not a present-moment mental event, but rather a mental event that had occurred previously and was being brought into focus. In contrast, in-action self-reflection served to bring attention to present-moment thoughts or emotions.

Key to these differences in how self-reflection was experienced was the degree to which the prompted check-in specified a mental event to focus on. As shown in Table 1, SIMA provides both general and specific mental events as part of the check-in activities. For example in prompts that specified a mental event Jay recalled, "I remember one checkin asked me to reflect on being grateful about something that occurred, so I thought back to see if I could remember an occasion." This contrasted with check-ins designed without specifying a mental event (i.e., general), prompting users to record their general current mood or thoughts.

However, the sequence of the check-in itself also played a role in differences between in-action and retrospective self-reflection. There were differences in how the same checkin was experienced later in the day versus earlier in the day. For example, when Sharon discussed her experience with an activity that prompted her to focus on feelings of compassion (i.e., specific mental event), she initially was, "trying to remember what

had happened" (i.e., retrospective), while, "the check-ins later in the day were different. I was noticing things in the moment." Other users shared a similar experience whereby an initial check-in that prompted a shift in attention to a specific mental event (e.g., gratitude) initially triggered a retrospective self-reflection, yet as the day progressed they engaged in in-action self-reflection as they anticipated subsequent check-ins would ask them to report on such events.

One question that emerges is whether or not differences in self-reflection matter when it comes to how curiosity is experienced. Given curiosity is largely defined as present-moment awareness, in-action self-reflection is more aligned with curiosity than retrospective self-reflection. Furthermore, the very idea of making use of the situated context is lost during retrospective self-reflection where the present-moment context does not relate in any way to the act of self-reflection.

In terms of the design implications, our findings may suggest that general prompts not specifying mental events to focus on are more likely to trigger in-action self-reflection than prompts that specify a mental event to reflect on. However, specifying a mental event such as gratitude or compassion, may still elicit in-action self-reflection if the user anticipates having to check-in throughout the day and self-monitors for such mental events.

Situated Effort and Engagement. The use of daily check-ins via notifications throughout the day meant the availability of attention and willingness to engage varied. While 83 % of users completed all three daily check-ins for the 10 days, and every participant engaged in at least two check-ins for the 10 days, users shared that had they not been part of a formal research study their engagement would have been lower for certain check-ins. Most by users cited perceived effort as influencing whether they ignored a check-in or engaged with it.

Once again differences between focusing on a general or specific mental event played a role. Across most users the check-ins that prompted a focus on a specific mental event, were perceived to require more effort. For example Claudia shared she "had one checkin on negative self-talking where I couldn't remember a moment, so I didn't know what to checkin with." Since our analysis linked specific mental events to retrospective self-reflection, this may suggest that retrospective self-reflection was perceived to require more effort since one may confront difficulty in recalling an event or taking time to recall.

Another aspect of the perceived effort was timing of the check-ins. Every user noted day-to-day variations as influencing their perceptions of how much effort would be required to engage in a check-in. For instance Nambia felt "it was easier to checkin when I had some downtime or I noticed something." Jay shared that "I don't think you're ever going to be able to get the timing right on the check-ins, I know for me some days it was right in the middle of something, … like I can't do this right now."

The design implication here is that focusing on in-action self-reflection may in turn also decrease users' perceived effort to engage.

4.2 Directed Non-reactivity on Decentered Factor of Mindfulness

In meditation, decentering occurs through both observing the coming and going of thoughts, and the act of letting go – freeing the individual from clinging to a single thought and shifting focus into the past and the future, rather than the unfolding present. SIMA attempted to engage participants in decentering through the use of directed non-reactivity, where they were explicitly directed not to react or attempt to analyze the focus of their attention, but merely become aware of it. The question is how does SIMA's approach to decentering change the way decentering is experienced.

Snapshot and a Shift. Differences between in-action and retrospective self-reflection influenced how users experienced attentional shifting that is at the heart of decentering. Reflection-in-action occurred most when check-ins served as a reminder to keep self-monitoring top of mind rather than elicit the self-reflection itself. In other words, the self-reflection was occurring in-between check-ins, therefore the attentional focus was different than in retrospective self-reflection experiences where the check-in itself directed the self-reflection and tracking at the same time. This is important because from deeper discussions with users, the in-between check-ins self-reflection took on a more attentional shift dynamic more similar to meditation experiences.

Check-ins that focused on a specific mental event allowed for a shifting between the current situational context and another specified mental event. For example if a user had on their mind the imperative to self-monitor compassionate thoughts, a situation in which they are angry may elicit a shifting towards a new more compassionate form of the mental event. As one user put it, "if I was thinking about the upcoming check-in, it did color my interactions a little." Jay shared that, "I was thinking about being grateful, and then when I was so angry one time, I thought – I'm so grateful I'm not that [expletive]." These experiences suggest that attentional shifting between mental events may better be induced through supporting reflection-in-action rather than retrospective self-reflection.

Non-reactivity as Highly Content-Oriented. Our findings suggest that the overall degree of attention shifting, when it did occur, was fairly limited. As discussed earlier, some check-ins resulted in little if no attentional shifting (i.e., snapshot) while others led to a more of an attentional shift. In the check-ins that did support attentional shifting, did so by prompting the user to hold a mental event to focus on in mind (e.g., being grateful) and contrast it with mental events as they occurred in-situ. The result is not just a limited attentional shift in that the contrast only occurs once, but an overall focus on the content of the mental events themselves. In discussing non-reactivity to mental events, every participant focused on the content of the mental event, rather than a focus on the ongoing process of mental events, as in mindfulness meditation.

For instance, many users sought to explore alternatives to the contents of the mental events they were focused on. Randy put it, "I found myself thinking about all the other times I felt happy, when I felt sad, or some positive things I could say to myself when I thought about the bad things I say to myself." Namibia shared that she, "also thought about all the times I wasn't being compassionate when I was being compassionate, not as a judgment, just as a … hey wait a minute moment." The result of a content-oriented

focus is that users felt a deeper analysis would have been helpful. As put by Randy, "I felt like the activities just tracked stuff and then asked me not to do anything about it." He continued," I mean what was the point? Either help me notice stuff in a specific way or help me do something after I notice it, but to do neither felt like a waste of time."

The design implications here is that while providing a specific mental event may induce reflection-in-action and better support attentional shifting, it also may lead to an increased content-centric experience. While this in turn may break from the traditional mindfulness orientation of not focusing on the contents or analysis of mental events, there may be opportunities for the integration of emotion-regulation strategies, which are commonly integrated in non-meditation therapeutic approaches such as Mindfulness-Based Cognitive Therapy (MBCT). For example, once users have noticed a context in which they could have more compassionate thoughts, rather than just direct users to not-react, they may be asked to reframe existing mental events with the more compassionate bent. This is stretching far beyond the original intent of mindfulness non-reactivity, but would be one direction that responds to users' inquiries into ways the app could help them engage in more self-regulatory behaviors – such as cognitive reappraisal [21].

5 Conclusion and Future Work

The idea of situated mindfulness and approaching it through the design principles of prompted self-reflection and non-reactivity then is not just meant to be yet another tool in the kit for mindfulness technology designers. Rather, it also presents a questioning around how technological mindfulness interventions operationalize mindfulness as a construct and in turn design for the activation and support of mindfulness state in-situ. We found that prompted self-reflection in-situ can be designed to support retrospective and in-action self-reflection, with in-action self-reflection more in line with the factor of curiosity of a mindfulness state. In regards to the use of directed non-reactivity, we found that a difference in the way self-reflection was experienced was pivotal. When self-reflection was more in-action, decentering relied more on attentional shifting, while retrospective self-reflection took on a more snapshot feeling. In turn, in directed non-reactivity during in-action self-reflection there was less of a focus on self-regulation. In summary, it may be that a focus on in-action self-reflection through specific mental events may benefit future designs. However, it is not clear what an increased content-centric focus means for decentered aspects of a mindfulness state. While it may be in line with user feedback and some therapeutic interventions, it may challenge definitions of decentering and non-reactivity, and align more with ideas of cognitive reappraisal and emotion regulation than traditional mindfulness.

Future work should consider a narrower focus on in-action self-reflection through the use of activities that direct the focus of attention on specific mental events, which in turn better explore a content-centric nature of the decentering experience. Exploring self-regulatory directions (e.g., cognitive reappraisal) rather than non-reactivity in the form of directed inhibition may provide deeper insights into how decentering can be experienced. In terms of methodology, future work may benefit from integration of

quantitative assessments to at least contextualize any thematic findings. This may include pattern analysis of behavior logs, or require tweaking instruments such as the Toronto Mindfulness Scale (TMS) to adjust the notions of curiosity and decentering to be applicable a situated context versus a set temporal period (i.e., meditation). A key limitation that future work may also address is how data is collected on mindfulness states. A per-session data collection approach through daily journaling might be stronger than an aggregate interview approach at the end alone.

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