

# Just-in-Time Adaptive Reflections for Supporting Physical Activity

Herman Saksono

Harvard University, hsaksono@seas.harvard.edu

Physical activity is an important health behavior but is often challenging to acquire. Through my study examining how families reflect on physical activity experiences while using a personal informatics tool called Storywell, I demonstrated how reflecting on positive experiences could induce an in-the-moment desire to be active. This opportunity suggests that artificial intelligence-based tool could invite reflections when being active is the most feasible, which in turn suggest the opportunities for just-in-time adaptive reflections. Although this design is promising, it is not without limitations. I suggest two potential constraints of this approach. The first comes from the design of reflections and the second comes from individual differences in their implicit attitudes towards exercising.

CCS CONCEPTS • Human-centered computing → Collaborative and social computing.

**Additional Keywords and Phrases:** Personal Informatics, Health, Reflections, JITAI

## 1 INTRODUCTION

Physical activity is a preventive health behavior that enhances physical and mental health as well as reduces the risk of chronic diseases [6, 7]. For example, moderate and vigorous physical activity is known to reduce the risk of hypertension and type 2 diabetes. However, only 50% of American adults met the recommended physical activity level [4].

Research in personal informatics has examined how digital tools can support health behavior, including physical activity. Such tools (i.e., fitness trackers) help people to self-monitor their physical activity data and set goals. However, in my study on how low-income families use fitness trackers, I found that people rarely reflect on their fitness data to generate the motivation to be active [11]. Furthermore, a meta-analysis shows that fitness trackers are less effective among low-income individuals [12]. Therefore, we need to investigate how to better support fitness data reflections among people with low income towards developing the motivation to be active.

With this open challenge in mind, I suggest that incorporating artificial intelligence (AI) features on personal informatics tools could better support fitness data reflections. Specifically, in the form of Just-in-Time Adaptive Reflections, which is a specific form of Just-in-Time Adaptive Intervention (JITAI) [3]. This approach is based on the evaluation of Storywell (Figure 1) with families of low-socioeconomic status [9, 10], which I will discuss next.

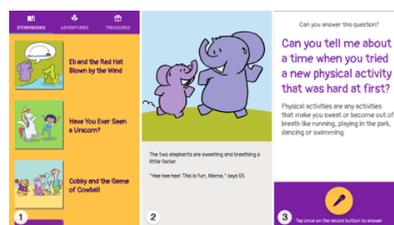


Figure 1. In Storywell, a family begins with selecting (1) then reading a storybook (2). Then the family is invited to reflect on their success experiences in being physically active (3).

## 2 STORYWELL DESIGN AND EVALUATION

One of the goals of Storywell (Figure 1) is to support physical activity reflections among families of low SES neighborhoods [9, 10] and help develop physical activity behavior. Storywell offered families to set fitness goals as a

family. Then the family can monitor their progress collectively. Finally, Storywell provided prompts for families to think about opportunities to be active. This form of reflection allowed families to remember how they managed to be active in the past and develop strategies to be active in the future.

To examine people’s experiences with reflections, I evaluated Storywell in a five-week qualitative study with families of low SES backgrounds. I gave fitness trackers to the parents and the children. I also helped them to install the Storywell app on their phones. Storywell has reflection prompts throughout the app. Figure 2 shows some examples of the prompts.

<p><i>“Can you tell a time when you tried a new physical activity that was hard at first? How did that activity become easier when you tried it again?”</i></p>	<p><i>“Can you describe a time when you enjoyed being active with your family? What are some nice things that happened to you?”</i></p>
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Figure 2. Examples of reflection prompt in Storywell.  
The left prompt is aimed at remembering self-efficacy. The right prompt is aimed at remembering enjoyment.

Sixteen families participated in the study. All of the parents were women, with a median age of 34 (*IQR* = 10). A majority of the parents self-identified as Black (*n* = 11) and three self-identified as Latino. The median income group was US\$ 23,017 or less (*n* = 8). I conducted over 26 hours of interviews which I analyzed using Grounded Theory [2].

### 3 REFLECTIONS IDENTIFY ABILITIES AND EMOTIONAL OUTCOMES

Through the study, I demonstrated that reflections evoked exercise memories that could enhance health attitudes [9]. First, reflections can help people remember their abilities, and remembering abilities could enhance self-efficacy (*n* = 3):

*P9: [Reflection] just makes us realize. Before, we weren’t thinking about how active we were.*

Second, reflection could help people remember the joyfulness of being active (*n* = 8):

*P8: One of the questions do trigger certain thoughts about, “Oh yeah. I remember when me and my daughter did this.” It kind of reminds, like, “Hey, we could do that again and get involved with that again. Why did we stop doing that?”*

Collectively, these findings show that reflections could reinforce self-efficacy and outcome expectations [9], two health attitudes that could induce health behavior [1]. However, such motivation is often impermanent:

*P7: [After reflection I said to myself], “Okay you’re going to go do this.” Then the emotion and your feelings then change, that you didn’t even complete the task.*

This sentiment is echoed by P8 who said that she “*might be a little more motivated*” if the question is prompted at the right time of day.

### 4 JUST-IN-TIME REFLECTIONS

The findings I discussed above show the opportunities and challenges of using JITAI for supporting effective reflections. In terms of the opportunities, the findings demonstrated that just-in-time reflections at the most appropriate time and place could motivate physical activity. Instead of using directive prompts, this approach uses reflective prompts aimed at helping users to remember their own successful experiences and support the desire to carry out the behavior. With this approach, the desire to be active would be grounded on the user’s own experiences.

However, some challenges need to be addressed as well. First, in Storywell, the reflections were externalized into verbal stories. This modality might not be applicable in all situations. For example, when a user is walking on their way home and passed by a park, it might not be appropriate to prompt them to verbally reflect on their physical activity experiences – especially if their current goal is to go home. Furthermore, physical activity requires specific preparations. For example, prompting a reflection when a user is near a park might be difficult to carry out if the user does not have the gears to be active. Thus, I suggest that a JITAI-based tool should also model the preparations of performing the behavior (e.g., wearing the right gears, whether the user’s immediate goal can be steered to physical activity). Then, this model should be incorporated into the larger model that determines when the reflection prompts should be presented.

Second, I suggest that individual differences could affect the motivation to carry out the behavior after a user was reflecting. Phipps et al. show that implicit and explicit affective attitudes are directly influencing physical activity [5]. Additionally, explicit affective attitudes and self-efficacy (i.e., perceived behavioral control) are indirectly influencing physical activity through behavioral intention. In other words, people who have positive affective attitudes towards physical activity might benefit more from just-in-time reflections. Therefore, just-in-time reflections might require interventions that enhance implicit attitudes.

However, there is a possibility that reflecting on the joyfulness of physical activity could positively influence implicit affective attitudes and induce physical activity. Rudman’s work suggests that emotional states influence and modify implicit attitudes [8], specifically through emotional reconditioning. Furthermore, such emotional reconditioning could be tailored using the user’s current contexts [3]. For example, by supporting users to remember the joyfulness of exercising at the same time of the week, under similar weather, or at a nearby location, as well as remembering the joy of exercising with friends and family members who are nearby.

With this open question in mind, I suggest that future work should investigate the effect of emotive reflections towards explicit attitudes (e.g., self-efficacy) and implicit attitudes (e.g., implicit affective attitude). Disentangling the effects of explicit and implicit attitudes will help decide the research directions of just-in-time reflections. If reflections solely influence explicit attitudes, then implicit attitude interventions are required for just-in-time reflections. Otherwise, if reflections also influence implicit attitudes, then just-in-time reflections are efficacious on their own by design.

## 5 CONCLUSION

In this position paper, I present a set of findings on the effect of reflections on physical activity, specifically among parents of low SES families. The findings demonstrated that reflections could enhance self-efficacy and emotional outcome expectations. Furthermore, reflections could create an in-the-moment desire to exercise. This finding suggests that just-in-time adaptive reflections could induce exercise behavior. However, I present two challenges of this approach. First, reflections – especially verbal reflections – may not be appropriate at all times. This constraint limits the efficacy of just-in-time reflections. Second, implicit attitudes could moderate the effect of reflections. As a result, just-in-time reflections might be more beneficial among people who enjoy exercising in the first place. Therefore, I recommend that future work should examine whether reflections are affecting explicit attitudes, implicit attitudes, or both.

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