Re-Live the Moment: Visualizing run experiences to motivate future exercises

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Abstract
Contemporary psychology theory emphasizes that people are more likely to achieve planned behavior if they are reminded of previous good experiences of that behavior. In this position paper we describe the results of a pilot study exploring the experimental in-the-wild validation of these findings in the context of run exercises. Based on today's technological improvements in data collection (advanced mobile and wearable sensors) and data visualization to capture and replay running exercise experiences, we created an experimental prototype that takes pictures during one's run and, based on the music one was listening to at the time, plays back slide shows of the experience. In an initial pilot study with 10 runners, we equipped 5 runners (the experimental group) with our prototype for 10 days and afterwards interviewed them on how the system influenced their exercise behavior.

Author Keywords
Behavioral change; Life logging; Multi modal capture; Autobiographical memories; Exercises; Running; Android.

ACM Classification Keywords
H.5.m. Information interfaces and presentation;
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Introduction and Related Work

Recent improvements in data collection (advanced mobile and wearable sensors), data storage (fast low power storage through SD cards, as well as unlimited cloud storage) and data mining (big data) have made "life-logging" – the recording of large parts of one's life in the form of photos, physiological data, online information, and/or movement traces – almost trivial [4,5]. One important use of this data is the so-called "quantified self" – the quantification of one's life (e.g., steps taken, emails sent, pulse rate) in order to better "manage", e.g., one's health, work, or private life, following the old management adage "You can't manage what you can't measure". Even so, *behavior change* is often not easy to achieve, in particular in domains like health where people are in fact aware of what is necessary to change (e.g., do more sports) but are still not motivated enough to engage in regular workouts. One interesting avenue to explore in this context is thus the use of *episodic memory* – the recollection of prior experiences with the help of "memory cues" (e.g., pictures, videos) [10] – to remind a person of pleasurable experiences. Contemporary psychology has found that people are more likely to achieve planned behavior if they are reminded of their (positive) attitudes toward such behavior [2]. In the case of sport activities, but not only, technology can thus help achieving planned exercise activities by first capturing the (enjoyable) experience of an exercise and then triggering recall of those memories in order to motivate future engagement in similar exercises.

Researchers have extensively studied the effect of visual imagery as a motivation strategy for behavior change in sport. Weinberg [12] provides a literature review on the relationship of imagery, sport performance, and motivation for sport. Kwan and Bryan [7] tested the impact of *affect* toward exercise attitudes, exercise self-efficacy, and intentions to exercise. They showed that a *positive affective response* (*positive emotional reaction)* to previous exercises was associated with greater intentions for future exercises. The inspiration for our project comes from a recent study by Biondolillo and Pillemer [3], who tested the effect of recalling episodic memory of a past exercise in order to increase future exercise motivation and activities. In their study, undergraduate students completed a two-part online questionnaire regarding exercise attitudes, motivation, and self-reported exercise activities. Participants were randomly assigned to two different groups (an experimental and a control group). In the first part of the questionnaire, people in the experimental group were prompted to think about a positive or a negative experience (episodic memory) as a motivation for their subsequent exercises. Control group participants were not asked to think about previous exercise experiences. After eight days, all participants filled another online questionnaire and reported their exercises of the previous week. Biondolillo and Pillemer found evidence that activating a memory of a previous exercise experience resulted in increased level and motivation for subsequent exercises.

Following the approach of the Biondolillo and Pillemer study, we want to employ a life-logging approach to record actual experiences from run sessions, and replay them back to participants in order to trigger a more vivid recall of the exercise, instead of simply asking participants to "think about a previous memory" related to exercises. We thus developed a mobile prototype that allows a runner to record (with pictures and MP3

audio) the experience of a run and "re-live" it later by reviewing it in the form of a short multimedia presentation. We then conducted a pilot study with 10 participants in order to understand the actual use of the prototype. Following the results from Biondolillo and Pillemer, our hypothesis is that participants that had the ability to re-live and hence recall their previous run sessions will engage in more subsequent running activities. In this workshop paper we describe the mobile prototype for recording different activities including run exercises and report on the pilot study.

Figure 1-a: Position of the setup on a runner

Figure 1-b: Chest mount with smartphone strapped in

Prototype

We built a wearable prototype that can capture the experience of a range of outdoor activities, including run exercises. It consists of a smartphone and a body-worn strap[1] for firmly mounting the phone on the participant's chest (Figure 1). The phone runs a custom Android application (Re-Live app) built using the *Funf sensing framework* [1]. The Re-Live app automatically takes images at regular intervals and records the current track being played on the phone's music player at the time. The app also collects additional sensor data, such as GPS location and accelerometer data. The current prototype automatically uploads the raw data to a secure server as soon as it is in range of a (usable) wireless network. From this raw data, we manually assemble a multimedia presentation of the recorded experience – a process we later plan to automate.

[1] http://www.velocityclip.com/

Measures

In our pilot user study we employed several measures based on the work of Biondolillo and Pillemer and other related studies. Such measures are primarily addressing the evaluation of motivation for running, self-reported run activities and intentions to run, as well as the qualities of the memories triggered as a result of reviewing recorded run sessions.

Run motivation

We used a modified version of the Behavioral Regulation in Exercise Questionnaire (BREQ-2) [8] in order to evaluate participants' motivation toward running exercises. This questionnaire consists of 21 questions on a 5-point scale (1 not true for me – 5 very true for me) such as *'I run because it is fun'* or *'It is important for me to run regularly'*.

Run activity and behavioral intentions to run

We measured the running exercise activities using the Godin-Shephard Leisure Time Physical Activity Questionnaire (LTEQ) [13]. Participants were asked how many times a week they engage in running activities for greater than 15 minutes of *strenuous, moderate and mild* intensities.

For rating *the intentions to run* we used a question proposed by Verplanken et al. [11]. It is a slightly

modified version of the question used for rating the *run activities*. We asked how many times per week participants would like to partake in running activities for greater than 15 minutes of *strenuous, moderate and mild* intensities.

Memory qualities
We used an adapted version of The Memory Characteristics Questionnaire (MCQ) [6] to evaluate the phenomenological characteristics of memories from the recorded run sessions. On a 7-point scale participants were asked how vividly they remember the run experiences and both positive and negative feelings felt during those runs.

Explicit use of the multimedia feedback as a motivation
We asked participants to list the strategies that they used (if any) to motivate themselves to run in the prior week. Then we specifically asked subjects that have recorded their running experiences using the wearable gear whether they have reviewed the multimedia presentation after each run as stimuli to participate in further runs.

Study Design

We recruited 10 participants for the study: 4 males and 6 females. The age of participants varied from 18 to 53. Six participants were students from the University pursing a Bachelor, Master, or a Ph.D. degree. Three were employed in the commercial sector and one was a housewife. Each participant was running for leisure few times a week. All of them had a daily exposure to technology and possessed a personal smartphone. Participants did not know each other and were recruited through on-campus advertising or directly through a local running club.

Each participant first participated in a face-to-face interview with two researchers. Interviews were conducted in a semi-structured manner. The goal of the interview was to understand personal habits while running, explore participants' motivations, and assess their attitude toward technology usage during the run. We used a voice recorder during all sessions and later transcribed the recordings verbatim. After the interview, each participant filled a short survey aimed at rating participant's motivation for running, run activities, and behavioral intentions to run.

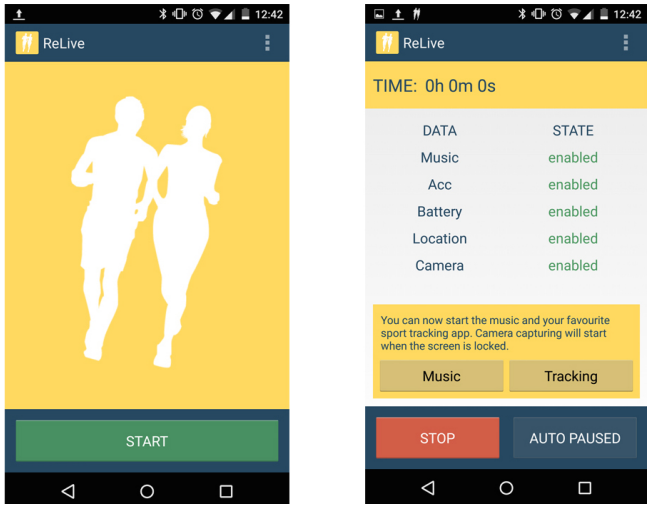

Figure 2: Re-Live app user interface

Half of the participants (the experimental group) were asked to participate in the trial and briefed on the format of the experiment. The other half (the control group) was simply asked to continue with their usual running routine and stay tuned for a follow-up questionnaire in 10 days' time.

We gave each member of the experimental group a smartphone (Nexus 5) with our custom app "Re-Live" pre-installed, and asked them to use the app (and its corresponding mounting system, see Figure 1) for 7-10 days whenever they would go for a run. Right before starting a run, a participant would need to launch the Re-Live application (Figure 2), optionally start a music player,[2] and then mount the phone in the strap (with the backside of the phone facing outward so that the higher quality back-facing camera would point away from the body). The phone would then commence to capture a picture every 20-30 seconds. Once back within WiFi range, the app would then upload the captured data to our secure server. A researcher then manually created a personalized multimedia presentation based on these captured images, overlaid with either a generic soundtrack or with one of the songs that the user listened to during the run (if the participant was listening to music). It took 20-30 minutes to prepare a multimedia presentation including the video rendering process. Once completed, we sent a link to the video to participants via e-mail and asked them to review it. Members of the control group did not receive any gadget and were simply asked to perform their usual running routine during the same amount of days.

Finally, we sent out another questionnaire after 10 days, asking participants complementary questions on the qualities of the memories from their previous run sessions. Members of the experimental group were additionally asked about their experience with the wearable setup. At the end of the study, we offered a gift card for each participant of the control group with a value of 10 Swiss Francs. Experimental group participants were engaged in a more compound study setup; hence we offered them 30 Swiss Francs valued gift cards.

[2] We briefed participants how to load their own music onto the phone, as well as asked them to associate the phone with their home WiFi in order to upload the data after a run.

Figure 3: Example of the video clip/multimedia presentation that we created for members of experimental group after each run session

Discussion

Four out of the 5 members of the experimental group reported enjoying the review of the multimedia presentation after the run (Figure 3). We asked them to provide suggestions what would they want to see on the web page in addition to the film. An obvious answer was an interactive map featuring the path covered during the run. Additionally the participants suggested augmenting the page with some statistical details from the exercising, such as a start/end time, distance covered, and information about runner's heartbeat during the run. Among other suggestions were:

attaching the music playlist used during the run; providing a space for note-taking; and giving a detailed statistical breakdown.

Sharing practices
While we only asked participants to watch the provided video at least once after a workout, three of our participants reported that they shared the video clip with a friend or a running mate. The reason for showing the clip to the friend was to share a life moment, regardless whether this friend was participating in the run or not. One participant stated in the exit questionnaire:

" – *Because it was something positive that happened to me, and I wanted to show the great views which I enjoyed while running."*

Naturally, from open-ended questions in the final questionnaire, we concluded that those participants who shared the film have also provided some ideas how to engage co-located and remote users into a post-run review session. As Ojala suggested in his study of online sport communities, shared content could be a powerful tool to strengthen social ties [9]. A live tracking feature on a map, and the ability to discuss a run with others were among top suggestions from our members to improve on the social interaction while reviewing their workouts.

Figure 4: Narrative Clip – wearable camera

User experience
We received mixed feedback related to the ergonomics of the experimental setup (Figure 1). Three participants found the wearable gear comfortable to mount and run with, while the other two found it rather uncomfortable and bulky. For them, it sometimes took up to 10 minutes to fix the smartphone into the cradle and find an appropriate position for running. Due to the malfunctioning of one of the Velocity Clip Chest Mount unit at the beginning of the experiment, we provided one participant with a much smaller Narrative Clip device[3] (Figure 4) as a stop-gap replacement. The Narrative Clip comes with a mounting clip and weighs only a few grams, making it much easier to affix to a running shirt. Consequently, the user reported that running with the Clip was much more enjoyable than with our original setup. However, most of the images taken by the Narrative Clip were blurred. Additionally, the Clip was quite unusable during late evening exercises, as its much lower camera quality would result in mostly black images in low-light conditions.

[3] http://www.getnarrative.com/

While our strap-mounted smartphone provided superior performance, its bulky weight and cumbersome setup did affect the run experience. We are thus investigating how to improve the system's ergonomics while keeping the image quality high enough.

Tracking workouts

During the face-to-face interviews, participants expressed an interest in tracking their performance during a run. Given that our Re-Live application does not provide this functionality, we decided to install the tracking application Endomondo[4] additionally on the test phone that we gave to each member of experimental group. The usage of this software was optional. Two participants have tried the application and discovered it useful to keep track on own exercises. Apart of standard statistical data such as covered distance, effective run minutes and calories burnt, a map was an important element to review after a run. Clearly, modern activity trackers are missing a context of the exercise. We believe that experience oriented tracking approach that we propose in the current study has a potential to improve running behavior.

Novelty effect

As with many user experiments, this one also faces the risk of the novelty effect, i.e. people increase their running due to the novelty of the system and not due to the system's treatment. We believe that such an effect will decrease if the experiment is extended over time. We can estimate the duration of the novelty impact on the measured metrics by having intermediate questionnaires during the study. Data collected while the novelty effect was visible can be weighted less or completely omitted from the analysis.

Next Steps

Our pilot study provided us with important insights on the feasibility of running such an experiment. We are currently looking into other outdoor sports, such as hiking or leisure cycling, in which the system's weight might not be perceived as problematic as during running. Cycling might additionally allow us to mount the equipment on the handlebar, instead of on the participant's body. At the same time, the Narrative Clip's limited camera quality may be enough for performing the experiment during the summer, when light levels are sufficiently high. We are working on a solution to automate the assembling of the multimedia presentations. Hence we are building an image selection tool that will remove poor images (blurred ones and images obscured by participants hand or any other object) or images that represent the same visual scenario or context.

We are currently revising our study protocols and plan to soon launch a larger study for evaluating our initial hypothesis, i.e. participants that had the ability to re-live and hence recall their previous run sessions will engage in more subsequent running activities.

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[4] https://www.endomondo.com/

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