

Physiology as XP – Body Blogging to Victory

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ABSTRACT

Quantifying how we change over time is a powerful tool, for it allows us to better understand the impact of events and our behavior on our psychological and physiological wellbeing. With understanding we can attempt to manipulate our behaviors so to improve coping strategies and outcomes (e.g. avoid undesirable mental states). As wearable sensors become more ubiquitous we may automate the collection of physiological data on a long term basis. As we collect more information about how our bodies react in different situations we can learn new things about ourselves that were previously concealed. While we may choose to keep this information private, web technologies allow us to share our data with others introducing new means to shape our behavior. We call this process *body blogging* - the act of logging physiological changes over a period of time or during specific events using web technology.

We've recently been exploring applications of body blogging in public spaces [1]. As physiological signals have become more prevalent in computer games (e.g. Wii Vitality, Ubisoft Innergy) and as newer games often feature online connectivity there is potential for games to be used as a means to modify behavior through body blogging. In this paper we introduce the concept of body blogging through our own experiences with the technique and discuss its potential uses. We also discuss how games might be used in conjunction with body blogging to modify behavior and the challenges involved in deploying such systems.

Author Keywords

Body blogs, life logs, physiological games, biofeedback.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

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INTRODUCTION

How well do you really know yourself? In the sea of information that is our lives we can only really pay attention to a small fraction of the information that flows around us. As such it's difficult to truly understand how our behavior and feelings are shaped by our life experiences. Quantifying how a given aspect of our self changes over time provides us with insight into our underlying behaviors (e.g. self-tracking calorie consumption can reveal when we put on weight). This process is known as *life logging* – the act of logging how an aspect of our lives changes over time. Life logs can be used to inform ourselves how our behaviors affect our psychological and physiological wellbeing. Subsequently we can use this knowledge to change our behaviors for the better (e.g. exercise more on the days we typically put on weight).

There is a plethora of information we can record about ourselves, subsequently we can find life logging applied in a variety of domains including: health & fitness (e.g. pedometers), telemedicine, self-experimentation (e.g. sleep management)¹ and affective diaries. Life logging can be facilitated through the most basic of tools like a pen and paper but with the advent of computers the level of detail and types of information we can record has inevitably increased. Computers also allow us to automate data collection making life logging less about the process of recording and more about the data analysis.

Wearable sensors allow us to continuously monitor our person without intervention, and as wearable sensors become more ubiquitous life logging is expected to become more popular. For instance certain phones and portable music players (e.g. iPhone, iPod) use accelerometers to support gesture based interactions, and as accelerometers are the sensor you find operating a pedometer these devices can in turn be used to track their owner's level of fitness.

SHARING LIFE LOGS AND BODY BLOGGING

The data collected in a life log is an intimate object. It can reveal a great deal about ourselves (e.g. our past and present psychological states) which we might not be comfortable with sharing. Subsequently the decision to distribute a life log depends on the collected data's context and the level of

¹ See "The Quantified Self" <http://quantifiedself.com> for more examples of self-experimentation through life logs.

intimacy we accord it. However in the right context life logs may be shared over the web which has its own benefits. For example those patients at risk from falls can be monitored remotely by their caregiver who can provide help in an emergency thereby providing the patient greater autonomy [2]. With shared logs we can also compare how different techniques enable certain life transitions. For example a person who measures their food intake, weight and exercise regime will over time produce a template for transitioning between different levels of fitness. As more data is shared on a topic such as this the more likely new life loggers can find techniques suitable for them.

Our physiology provides a wealth of information about affective, cognitive and physical state. Using wearable sensors we can collect this information passively from the user and record long term trends. In conjunction with a few other sensors we can provide greater context to this data. For example if a subject's heartbeat rate is being monitored, an accelerometer can be used to determine if increases in this metric are due to motion and if not allow us to focus on other causes. As this data provides a wealth of information about ourselves and can be collected passively of the user there is potential for designing new life logging applications. The web allows us to subsequently share this data, which can lead to new paradigms in biofeedback interaction (e.g. sharing real time physiological data on a social website may lead to peer pressure regulated psychological states as friends of the subject begin to relate given social interactions with certain changes in their physiology) and thereby behavior modification. We call this process *body blogging* - the act of logging physiological changes over a period of time or during specific events using web technology.

APPLICATIONS OF BODY BLOGGING

Body blogging has similar applications to life logging. However with the ability to share our data different techniques can be employed in the evaluation and modification of our behaviors. For example, the Nike+ iPod sports kit allows accelerometer data to be uploaded to a social network allowing friends to share their best running times. Shared running data enables friends to track each other's progress and provide motivation to each other (e.g. when a user's running performance decreases friends may suggest new running techniques) and also encourages competition (e.g. competing for the fastest lap time on a local run). By sharing their performance a runner's introspection of their data is provided by a group rather than themselves potentially leading to more effective behavioral modification (e.g. sustained exercise).

In a more intimate example of body blogging, BP-Chart (<http://bp-chart.com>) allows users to upload and share their blood pressure measurements and track long term changes. This data can be shared with a user's physician or the public at large. Websites like BP-Chart provide users the tools to visualize the physiological changes they undergo

over time thereby helping them to better manage their wellbeing in conjunction with advice from a medical professional. Fitness and medical body blogs are a popular format as the metrics involved are easy to understand by the user and so market as a tool for behavior modification. For example EA's upcoming Sports Active game is expected to allow players to upload and share their exercise related heartbeat rates. As most people are aware that heartbeat rate changes with physical effort, the shared exercise data will be understandable at a basic level between friends. These existing applications only represent a small sample of what may be realized with body blogging.

We could also use body blogging to gain introspection into our online social interactions. For example in an affective diary by Microsoft [3] a user's psychological state was tracked over the course of the day using physiological sensors (e.g. arousal, motion) and their mobile phone (e.g. texting). The collected data was presented to the user at the end of the day in order to help them reflect on how they managed their interactions. As a life logging application this provides personal introspection for the user; however our interactions can be perceived differently across the people we interact with. In a body blogging version of this setup, friends of the user could be allowed to contribute information to the user's diary thereby providing a richer experience to reflect on. In a familiar setting, family members could use a shared affective diary to understand how their interactions affected each other's psychophysiological states and help them for example to understand why conflicts may arise (e.g. if somebody is unexpectedly out all night, the affective diaries would record any anxieties the rest of the family may have, this data can then be used in turn to help the person who caused the anxiety understand how their actions affected the rest of the family). Taking this forward with real time body blogs, we could tag our online social interactions with our current state thereby providing a physiological context in which an interaction occurred. As an online message does not convey our emotional state as well as being physically present making others aware of our body's state in some form in remote interactions might lead to more effective communication.

BODYBLOGGING IN PUBLIC SPACES

We've recently been exploring applications of body blogging in public spaces. We've implemented a prototype system which monitors a subject's heartbeat rate 24 hours a day. The subject is able to track their physiological changes through a web interface in real time and review past data. The system updates a twitter feed (<http://twitter.com/bodyblogger>) every 30 minutes with the average of the past 30 minutes of physiological activity. From a life logging perspective, this platform has allowed our current subject to understand various things about their day such as how they respond to situational stress (e.g. arrival of an important e-mail caused their heartbeat rate to increase 30 bpm over their baseline), physical activity (e.g.

they walk with a speed of 100 bpm) and how alcohol interferes with their sleep cycle (e.g. alcohol increases heart activity significantly over the normal baseline while also increasing restlessness during the night).

This information provides the subject with the means to alter the behaviors associated with undesirable states. However the online component of this system adds a new dimension to behavioral modification. For example the subject in question is somewhat of a night owl which can negatively affect their social interactions during the next day. The body blog provides the subject's online friends a means to evaluate their current wellbeing (i.e. sleep shows up as a noticeable decrease in heartbeat rate during the night) and subsequently they can inform the subject they should go to bed or they can modulate their own interactions with the subject for the duration they remain in this state. Long term tracking provides a greater ability to do this as more sleep rhythms are recorded and the subject's social network build up their own contextual framework around it.

We're also in the process of implementing new types of body blogging application with our framework. For example a community driven music player for mood modification. Here the subject's heart beat rate is displayed in real time on a website. The online community can then select from a range of musical tracks for the subject to listen to. The resultant effect is then shown in real time providing users with a personal connection to their method of modifying another person's physiological state. What we'll be interesting here is the type of music users will select to affect the subject as they go about their day (e.g. given a range of different valence songs will they choose more negative or positive tunes to modulate the subject).

DESIGNING USABLE BODY BLOG INTERFACES

Though body blogging offers new means to evaluate and modify our behavior, which we are only just beginning to explore, it is not without its problems. While continuous data monitoring may provide body blogging its greatest strength in providing a long term record of the physiological changes the user undergoes, it is also its biggest weakness as we need to figure out how to make this data meaningful for both the user and their followers. For example, in the fore mentioned affective diary by Microsoft [3] changes in the user's state were presented as a time series graph (e.g. pulse vs. time). While this format may be interesting for an observer, for the user reflecting on their day's experience this format was somewhat disembodied from how they actually experienced the day. A better format was to embody this information as a visualization of their bodily state thereby allowing the user to more readily associate their experience of the day with the collected data.

As such the key challenge in creating viable body blogs is in making the interface display the collected data in a manner meaningful for the aims of the participants involved in the application. For example in our music player

meaningful feedback is provided to the community via a time series graph of physiological activation. With this level of detail they can readily associate a song with a given affect and thereby derive some meaning from it (e.g. subject's physiological state is excited by song N). The interface will also need to take into consideration any obsessive or hypochondria tendencies the user may have as the data could be misconstrued to justify a negative perception of them self that doesn't exist.

MODDING GAMES WITH PHYSIOLOGY INPUT

Computer games are an inherently interesting form of entertainment. Over recent years, attempts have been made at adding new twists to computer games through physiological adaptation. As physiological signals provide a continuous stream of data about the player's psychophysiological state a real time system such as a computer game can readily take advantage of this input and modify itself to better facilitate a player's needs (e.g. avoid negative emotional states like frustration [4] or actively promote a desirable one like flow [5]).

Through a player's physiology games can be made to passively adapt to their users state (e.g. arousal can be used to control game difficulty) or provide the player a new means to actively control play through conscious control of their physiology (e.g. alpha brainwaves can be used to control a binary switch or dial). In some circumstances, the line between passive (i.e. where the game is responsible for modifying the player's state) and active (i.e. where the player is responsible for modifying their state) systems becomes blurred [6]. Since physiological signals are influenced by a multitude of internal and external processes no one signal is truly representative of any given process, and during play different processes may become more dominant.

In designing physiological games it is important to make a physiological-game interaction meaningful for the player. For example in a World of Warcraft mod alpha [7] brainwave activity was mapped to the druids shape shifting ability. During low alpha activity (agitated player state) the bear form would be triggered and with high alpha activity (restful player state) the humanoid form would be triggered. This relationship is very intuitive as the players relaxed and stressed states map to similar avatars states thereby making the interaction meaningful for the player. A similar dynamic would be in the activation of a stealth power in a sneaking game (e.g. player has to relax to activate their stealth ability). In conjunction with related physiological measures (e.g. gestures), we can build more complex models of the player's psychophysiological state and so we can realize more meaningful physiological-game interactions. The research focus here would therefore be on determining which metrics in combination provide the player the greatest meaning for a desired physiological-game interaction using the minimal number of inputs.

PHYSIOLOGY AS EXPERIENCE POINTS

In a recent presentation at DICE 2010, Jesse Schell gave a talk on how game designers were using real world – game interactions to influence the player (e.g. allowing users to improve their avatar's game stats by awarding experience points for subscribing to a real world service). Subsequently Schell postulated that the future of games lied in providing more of these types of interaction thereby making the real world an extension of the virtual world. As tasks presented in a game format can improve a user's motivation for performing them, this future is likely to see such games used in life logging. For example the Epic Win App for the iPhone (<http://epicwinapp.com>) presents the user's to-do list in the form of an RPG awarding experience points for completing real world tasks thereby providing a meaningful way for the user to evaluate their work progress.

As physiological signals become a more prevalent input in computer games, and as games more often than not feature online connectivity, body blogging may provide an avenue to realizing this future through physiological games. As physiological games mirror our own psychophysiological state, players are always going to be aware at some level that the game is providing a biofeedback experience (even when the physiological-game interactions are not explicit). Subsequently if we were to allow players to review and share the physiological responses they experienced during play they may learn new facets about themselves (as with a life log) as well as how to modify their behaviors outside the context of the game.

In realizing Schell's vision, body blogging can be used in conjunction with games to modulate a person's psychological and physiological state over a long period of time. For example, physical fitness is a transitory state, once a person stops exercising their current level of fitness deteriorates. If a user is monitored using a body blog they can be informed when their fitness decreases by the system or their social network. Using games we can make this data more meaningful (and thereby more motivating), for example we can award achievement points for attaining physiological states (e.g. increased heart recover rate) which are subsequently used in other game experiences (e.g. physiological gained experience points could be used to provide stats for your avatar in a racing game). In this instance, as the monitored physiological states are transitory so too are the achievements, and so continued motivation is provided in the form of achievement maintenance as in order to maintain their game stats they have to maintain their own physical condition as well.

MOTIVATION

Deploying body blogs in a game format opens up new and exciting means for regulating our psychological and physiological state over a long period of time. However questions remain over how: -

1. We present physiological data in manner that is meaningful to both the subject and their followers given the application context.
2. What is the minimal combination of physiological metrics that would provide the subject and their followers the greatest meaning?

We believe, as this workshop focuses on shared physiological gaming experiences, will prove beneficial in tackling these issues as they are relevant to both domains.

EXPECATATIONS

During the workshop we aim to open a dialog on the type of body blogging experiences we might facilitate using computer games (e.g. discuss what aspects of our psychophysiology are suitable for regulation and what type of game motivations could facilitate this). We would also like to discuss how we might present this data in a meaningful manner while ensuring the shared aspect of this data cannot be misused. For example our body blogging application does not provide instantaneous feedback. This design decision was undertaken to prevent the public at large from actively trying to manipulate the subject in real time. As our own personal experience had taught us, outside a structured setting, participants in such projects can get out of hand (e.g. provoking a physiological response by insulting the subject).

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