Biometric Storyboards to Improve Understanding of the Players’ Gameplay Experience

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Abstract
Due to the specific characteristics of video games most of the established user research methods cannot be used the same way for video games. One of the challenges is to gain insight into how players feel and behave when playing a game. Having a better understanding of players’ gameplay would help developers to optimise the experience of their game.

In this paper we are reporting our current work on introducing a new technique called ‘Biometric Storyboards’. Narratives have always been part of the user experience process to communicate how and why a design would work. We are promoting a new methodology based on using stories (or rather storyboards), where we graph the player's gameplay experience over a longer period (e.g. a level of a game). Sometimes the limitations of stories are that they are a personal and subjective experience, from the perspective of the consumer. Thus, they become a fairly intangible experience to record. Using our proposed method of the biometric storyboard, the seemingly elusive narrative experience becomes a data-supported recorded asset.

The graph itself is calculated based on (1) player’s biometric responses, (2) post-session interviews, (3) players’ self-drawn diagrams of their gameplay experience and (4) coding player gameplay behaviour.

Our paper reports the three evaluation stages and iterations of this method on two commercial console games that were still under development, and we explain how these approaches helped the developer to have a better understanding of how players interact with their game, ultimately enhancing their ability to effectively optimise the experience of the final release.

Key Words: Biometrics, storyboards, video games, user experience (UX), visualisation, user-centre design.

1. Introduction
In recent years, there have been many changes in video games development, including new business models, widening player demographics and new controller interfaces. These present opportunities, but also additional uncertainties and, in combination with escalating design and development costs, developers are under pressure to ensure that every game is as big a success as possible. As a result, the demand for studies dealing with users and their interaction with video games has grown in the past few years. Although Human-Computer Interaction (HCI)
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Methods have made progress in understanding the usability of productivity applications, the specific characteristics (such as emotion and intended challenge) of video games mean that many of the well-established HCI methods of user research cannot be applied to video games in the same way. The most common of these HCI methods are subjective self-reports through questionnaires, interviews, and focus groups (Fulton & Medlock, 2003), as well as objective reports through observational video analysis (Lazzaro, 2004). These methods have been adopted with some success for evaluating video games, typically allowing them to identify major gameplay navigation and content issues, as well as understanding of the attitudes of the users. They may not identify some player issues, providing information on the finished experience, rather than continuously throughout the course of the game (Mandryk & Atkins, 2007). They can also interfere with gameplay and create an artificial experience, producing inaccurate results.

Biometrics in video games: In order to overcome these limitations it would be advantageous to use methods which can capture data directly from the player continuously and unconsciously. One such approach which addresses both of these requirements is the use of physiological sensors attached to the player’s body (biometrics), allowing continuous data capturing such as Heart Rate (HR) or Galvanic Skin Response (GSR), in a manner which does not require either prompting from a moderator, or conscious thought from the participants. Researchers have used physiological measurements to evaluate emotional experience in video games. Hazlett (2008) describes the use of facial Electromyography (EMG) as a measure of positive and negative emotional valence during interactive experiences. Ravaja (2006) measured facial EMG and cardiac interbeat intervals in addition to self-report ratings to index physiological arousal and emotional valence. Mandryk et al. (2006) have used HR, GSR and EMG to create a modelled emotion for interactive play environments. Nacke and Lindley (2008) have created a real-time emotional profile (flow and immersion) of gameplay by using facial EMG and GSR. In their work with Grimshaw (2010) they looked at effects of sound and music in a video game on players’ EMG and GSR. Drachen et al (2010) reported a case study on GSR and HR correlations with player gameplay experience in First-Person Shooter games. The Yannakakis et al. (2008) study statistically correlated psychophysiological and subjective measures of emotional components of player experience.

Stories and Storyboards: Narratives have always been part of user experience process to communicate how and why a design would work (Quesenberry & Brooks, 2010). Storyboards have become popular techniques for visualising human-product interaction, not only in design education, but also in design practice. They can help the design team focus on the user’s actions, understanding, and experience instead of the appliances’ physical form. Their format ranges from
very sketchy to highly detailed, depending on whether they are used to explore new ideas, report existing situations, or present design concepts for criticism and discussion (Stappers et al., 2011). Stories and narratives are a personal and subjective experience, limited to the perspective of the consumer, and therefore become a fairly intangible experience that is difficult to record. Using our proposed approach of biometric storyboarding, the seemingly elusive narrative experience becomes a data-supported recorded asset.

**Visualisation:** Visualisation is continuously growing tool, with research efforts expanding into many different domains. Visualisation tools address the challenge of analysing and presenting overwhelming amounts of data (in our case, rich biometric data) by combining methods from various disciplines, including information visualisation, HCI and data analysis techniques from statistics, data mining, and others (Thomas, J., & Cook, K.).

In this paper we are reporting our current work on introducing a new technique called ‘Biometric Storyboards’. We are promoting a new approach based on using stories (or storyboards), by constructing graphic representations of the player's gameplay experience over a longer period (e.g. a level of a game or several hours of play).

2. **Data Collection**

The graph (Figure 7) itself is calculated based on (1) player’s biometric responses (2) player post-session interviews to explain ‘why' the change in their signal occurred (3) players’ self-drawn diagrams of their gameplay experience and (4) coding player gameplay behaviour (or context).

**Biometrics and post-session interview:** By utilising measurements of arousal in players’ galvanic skin response (GSR) and heart rate (HR) during video game playtesting, specific events with higher impact on the players’ feeling are identified as potential usability or UX issues, generating a log of issues for analysis. In the post-session interview immediately after the gameplay session, each player was asked to recall these specific moments and to inform the experimenter of their thoughts and most importantly ‘why they felt that way’, with the video footage (Figure 1) available for playback if the player did not recall fully (Mirza-babaei & McAllister, 2010). This approach helps us to identify not only the negative usability and user experience issues, but also the events in the game which have a positive impact on player experience.
Figure 1. Example Screenshot of the gameplay video

Figure 2. Example of player drawn diagram of their gameplay experience

**Players’ self-drawn diagrams:** Players are provided with blank graph paper sheets and asked to ‘draw their experience’ at the end of each level (which provides a natural break in the gameplay experience). These player drawn diagrams (Figure 2) enable us to capture a player’s overall experience of each level immediately after each is finished, without interruption or prompting from the experimenter. It is shown by this method that many players are only able to recall details from the very beginning and the very end of that gameplay section (serial position effect), but combining these player drawings with their biometric responses and their post-session interview, we are able to address this problematic gap.

**Coding player gameplay behaviour:** we include the player’s gameplay behaviour coding (Figure 3) when generating the biometric storyboards to help us better represent an accurate reflection of the player’s gameplay experience. The combination of this coding and players biometrics data and post-session interview would enable us to explain ‘what the player does’ ‘why they did it’ and ‘how they felt’.
3. Iteration and Evaluation

3.1. First Iteration

An unreleased commercial single player first person shooter console game was subjected to single player user testing for approximately one hour per player, and with 10 players: 5 self-identified mainstream gamers and 5 core gamers. Only a portion of the game was complete to a level of quality indicative of the final product, and only these sections were tested. Testing was conducted over 3 days in laboratory conditions. Participants played the game on an Xbox 360 connected to a HD television. Video cameras recorded the player, biometrics kit capturing players GSR and realtime footage from the game console was simultaneously streamed to the observation room next door. All feeds were composited together on a single display, and recorded for later analysis. The game’s producer, and experiment conductors monitored the participants’ play from the observation room. The experiment conductors had spent some time familiarising themselves with the game before the test sessions, and the producer was able to identify when players were not playing the game as intended. Following the user test sessions, a Biometric Storyboard was produced of each level for a casual and core player. Figure 4 shows a selected diagram. Each vertical line is one minute of gameplay, positive comments are in green and negative are in red. It shows in both levels minute 10-20 are offering a poor experience, and gamers are experiencing frustration and lack of enjoyment.
3.2 Second Iteration

The second experiment was conducted under similar conditions to the first experiment, but with a different set of 9 participants. The new version of Biometric Storyboards were refined based on the feedback from the game’s producer. The feedback suggested that the first design of Biometric Storyboards was difficult to compare between players.

Figure 5 shows the second design of the Biometric Storyboards from the second experiment. The following are the main differences in the new design: 1) each level was divided into thematic areas, this would make the key sections easier to compare; it also shows the time it took the player to complete that area. Also, it makes it easier for game designers to see where the issues are exactly. 2) Brief text explanation on player’s experience story with reference to arousal events. (Figure 6) 3) Green or red dots shows the positive or negative experience (mainly from the player’s drawing and interview). 4) Screenshot of game events (removed from the diagram since the game is unreleased).

Figure 4. Biometric Storyboards from the first design

Figure 5. Biometric Storyboards second iteration
3.3 Third Iteration

To explore the effectiveness of this approach on different types of video game, a third experiment was conducted on an unreleased commercial sandbox (free-roaming) game under the similar conditions to the first and second experiments. A new iteration of Biometric Storyboards were refined based on further feedback from the game’s producer and internal user research team. The feedback suggested that the biometric graph should go down to indicate negative player experiences to better represent the players experience, and to better draw attention to and isolate the negative experiences. Secondly, they reported difficulty in pinpointing the exact moments highlighted by the red/green dots, which were key to providing context and establish cause and effect. (Figure 7)

Figure 6. Biometric storyboards explanation: Examples of arousal explanation:
1: player interacts with objects. "Nice being able to move these objects." 2: first open space. 3: too much text instruction bored the player.

Figure 7. Biometric Storyboards third iteration (Level names and some explanation information has been removed as the game is unreleased)
4. Discussion

Correlation between biometrics and gameplay events: Visualisations of the players’ biometrics and gameplay events were helpful to understand and explore correlations between changes in players’ biometrics (feeling) and the corresponding events or behaviours. For example, we saw the Biometric Storyboards being used to explore behaviour of several players during a single event. Understanding how players are motivated to perform particular tasks in gameplay environments is a vital tool for game designers.

Comparison of players’ behaviour: Once we have created a series of these Biometric Storyboards, we can compare the gameplay journeys of different players and utilise them to spot key trends in gameplay behaviour. Our result shows that the players’ background profiles and ‘psychographics’ (motivations) can be reflected in a regular pattern of behaviour and subsequent enjoyment in their corresponding Biometric Storyboards.

Whole session overview: By visualising the whole gameplay session, Biometric Storyboards were able to provide a good overview across all events, levels, and missions etc, thus enabling the developers to quickly scan for key elements in level design, player performance and player emotions.

Verifying the intended design decisions: Some producers have been using the Biometric Storyboards to compare the way players felt during a designed game event to what the designer had originally intended players to experience. Suitably equipped to understand the effectiveness of the design process, these designers were able to verify the success of their game design environment, and judge whether the intended game experience matched that of the actual player experience.

Simplicity: Biometric Storyboards have been formed and iterated based on the demands of our target users to deliver tools that are simple, easy to understand and interpret with an immediately apparent benefit.

User-centric Design: Our understanding of the game development process and the relevant needs in the working environment has helped us to design visualisations which closely match the requirements and language of our clients, and the subsequent level of detail necessary for the task. Poorly implemented and integrated tools would incur an additional time cost to our target users, rendering them unusable to game developers and therefore quickly disregarded.

Familiarity: Our target users (game developers and producers) are familiar with various data representation techniques and visualisations of game metrics. Similarity between Biometric Storyboards and these existing models helped to support communication with and between developers and we feel it has increased the acceptance of our new tools.

Support collaboration: Biometric Storyboards enabled increased collaboration of user researchers, game designers, game developers and producers. We saw that producers and designers were able to more effectively discuss design strategy
using the Biometric Storyboard as evidence for player behaviour. Visualising biometrics responses, usability and UX issues into these storyboards has made previously complicated and advanced approaches accessible to a wide audience, including those with only a very limited knowledge of user research and the other areas of expertise utilised to produce the storyboards.

5. Conclusion and Future work

Overall, the recommendations generated from our three iterations, together with a user-centred design process, has helped us to design a tool that has provided game developers with an increased understanding and enhanced communication, leading to a better understanding of players gameplay experience. Successful deployment of our Biometric Storyboard technique resulted from (a) the approach’s simplicity, (b) strong user involvement throughout the entire design process, and (c), an integration of the target users’ existing tools (storyboards have been widely used in the video game and movie industries). A focus on simple solutions and user-centred design allowed us to iterate our earlier prototypes to our current iteration. The third iteration of our Biometric Storyboard technique generates biometric-based visualisations which provide better support to problem-solving and communication, greater insight into player gameplay experience, and better fits into the work process of video game development than traditional HCI user research methods.

We are constantly working with developers and industry professionals to evaluate and iterate this approach using commercial console games that are still under development. We had positive feedback on how Biometric Storyboards have helped developers to gain a better understanding of how players interact with their game, ultimately enhancing their ability to effectively optimise the experience of the final release.

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