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GAMES AS AN EMOTIONALLY DRIVEN EXPERIENCE

A PILOT OF A NEUROSCIENCE PLAYABILITY TEST MODEL

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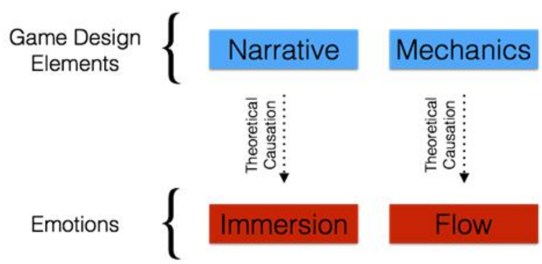
INTRODUCTION: THE IMPORTANCE OF QUANTIFIABLY LINKING GAME ELEMENTS WITH PLAYER EMOTIONS

It has long been argued that games are emotionally driven experiences. Immersion theory states that game elements such as narrative determine whether or not players commit mentally and emotionally to the game world. Conversely, flow theory focuses on game mechanics and how their usage brings players to a feeling of heightened focus. Both theories are valuable, as well as complementary.

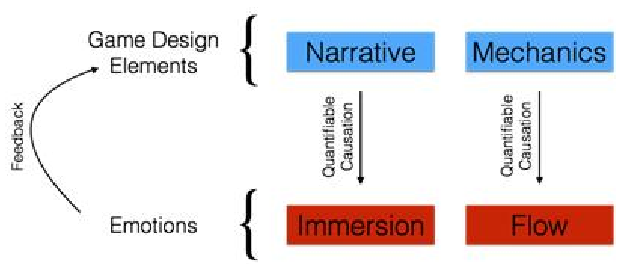
However, until now, there existed a glaring disconnect between the game elements (narrative and mechanics) and the player's emotional response. There was simply no reliable way to quantify player emotions continuously throughout gameplay, and hence no reliable way to link cause and effect. Previous testing frameworks (e.g. questionnaires, heuristic testing, focus groups) provided only a selective and inexact picture of the player experience. Rationalisations and memory / time discrepancies were common culprits that dogged research in the area. In other words, we knew that game elements mattered. We also knew that emotions mattered. Unfortunately, linking the two with any degree of precision or continuous data was not possible. (See figure 1.)

FIGURE 1.



The paper demonstrates a practical way of measuring player emotions continuously throughout gameplay. As such, it provides a scientific, complete, and accurate player feedback mechanism to game developers. In using the method, both gamers and the games industry as a whole can benefit from a newly found understanding of subconscious feedback. (See figure 2.)

FIGURE 2.



The stakes are high. The global gaming industry totaled USD 66 billion in 2013 (Reuters, 2013) and is growing in leaps and bounds. The study demonstrates the immediate value of applying neuroscience to gaming. A playability test for player emotions can give the gaming industry a tool for creating better games by understanding player unconscious feedback. It is hoped that through the sharing of the paper's experience of improving client games using neuroscience, other game studios will be inspired to adopt the approach.

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METHODOLOGY

The biggest problem facing any game research has been the inability to reliably and continuously track player emotions throughout the entire duration of gameplay. Post gaming session interviews are inevitably spotty due to the fact that the human brain, while amazing at processing emotions, cannot reliably recall cause and effect, nor pinpoint them in time. Verbalised recollections also suffer from rationalisation bias, i.e. when participants attempt to explain their decision making in logical terms, where there usually is no such logical progression. On the other hand, behavioural observation and collected analytics only capture corollaries of player decision making, not their actual emotions.

Neuroscience circumvents these problems altogether by measuring the very origin of all human perception: the eyes and the brain. This can be done without observer interference, with quantified data being collected continuously. Emotions can thus be measured directly. The way this has been achieved in this paper is described below.

Sample size & structure

In total, 10 game titles were analysed across four research projects. Four genres were tested: fighter games, first person shooter games (FPS), racing games, and endless runner games. Each project included 30 participants, giving a total of 120 participants spread across the four projects. Each 30 participant cohort included three types of players of varied ability: low-, mid-, and high-level gamers.

Measurement technologies and output metrics

Three different technologies were deployed simultaneously for collecting measurements. First, eye tracking recorded player fixations (gaze points) and saccades (eye movement from one fixation to the next), and more generally served as a marker of events taking place in the game over time. Second, electroencephalography (EEG) measured brain waves, enabling the direct recording of emotions. Third, skin conductance levels (SCL) measured arousal by way of skin perspiration. (See figure 3.)

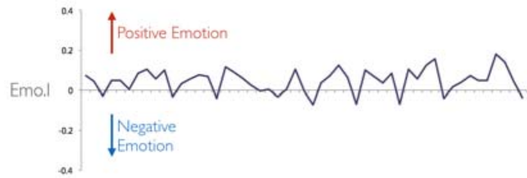
FIGURE 3.

Technology	Hardware model	Output metric	Notes
Eye Tracking	Tobii 300TX	Fixations, saccades, screen recording	Eye tracking for visual reference when reviewing quantitative data
EEG	64 electrode Brain Products	Emo.I index	Measured as the alpha wave from the frontal lobe. Based on the Frontal Asymmetry theory. Measures emotions.
Biometrics	Biopac MP150	Galvanic skin response (GSR) or skin conductance level (SCL)	Measures skin perspiration levels (via electrical conductance). Measures arousal.

Immersion

Immersion theory states that game elements such as narrative determine whether or not players commit mentally and emotionally to the game world. Immersion as a feeling involves a lack of awareness of time, a loss of awareness of the real world, an involvement and a sense of being in the task environment (Cairns et al., 2006). Immersion is not only viewed as a positive experience: negative emotions and uneasiness (i.e. anxiety) also run high. An immersion pattern is actually characterised by the oscillation of emotions, most of which should fall above the baseline (i.e. above zero, or above the brain's rest state). (See figure 4.)

FIGURE 4.



Game elements (cause) that influence immersion (effect) are:
- Narrative (mostly for role playing games)
- Strategy (mostly for real time strategy games)
- Tactics (mostly for fighter games)
- Graphics
- Audio (soundtrack, ambient sounds, game element sounds)

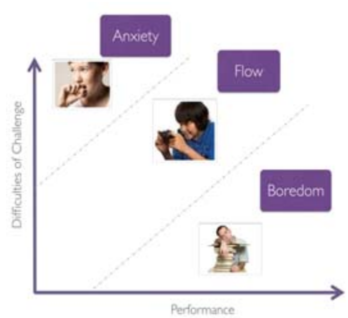
The typical symptoms of the immersion state are:
- High engagement
- Loss of realisation of reality
- Loss of time
- Addiction

In this paper, immersion is quantified as the Emo.I index. It is measured as the alpha wave from the brain's frontal lobe. The measure is based on the Frontal Asymmetry theory. The better a game is at inducing a gamer's Emo.I to oscillate, the higher the gamer's immersion.

Flow

Flow theory focuses on game mechanics and how their use brings players to a feeling of heightened focus. The concept of flow refers to an activity associated, subjective experience under conditions of a perceived fit between abilities or skills and task demands in the context of clear goal settings (Ulrich et al., 2013). What this essentially means is that flow is a corridor. Fall below the corridor and gamers get bored. Rise too high above the corridor and gamers get overly stressed and anxious. The idea is to guide gamers right into the corridor for optimum experience. (See figure 5.)

FIGURE 5.



The game elements (cause) that influence flow (effect) are:
- Game mechanics
- Balance between challenge and player ability
- Game objectives
- In game feedback systems

The typical symptoms associated with flow are:
- Intense and focused concentration on the present moment
- Merging of action and awareness
- A loss of reflective self-consciousness
- A sense of personal control or agency over the situation or activity
- A distortion of temporal experience, one's subjective time is altered
- Experience of the activity as intrinsically rewarding and purposeful

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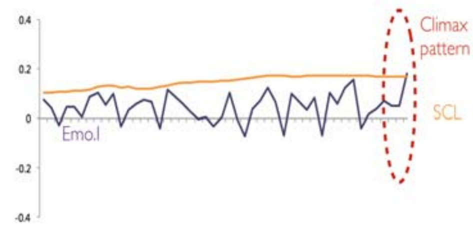
Achieving flow means the confluence of three separate brain patterns. First, there exists strong emotional oscillation. This is measured by the Emo.I index, with oscillations mostly recorded above the zero value line. Second, there is an accumulation of arousal. This is measured by Skin Conductance Level (SCL), and should gradually build up over the course of gameplay. Third, there should be a climax moment towards the end of the gaming session. This is usually seen as a spike in Emo.I and elevated arousal towards the end of an in game challenge. (See figure 6.)

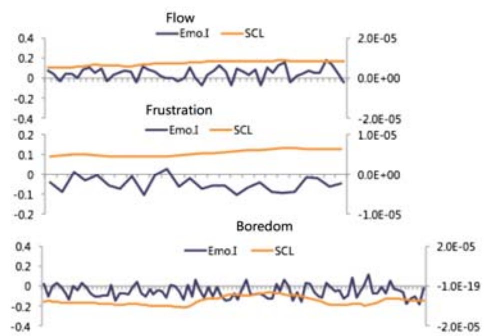
FIGURE 6.



Several illustrations of the framework for Emo.I + SCL

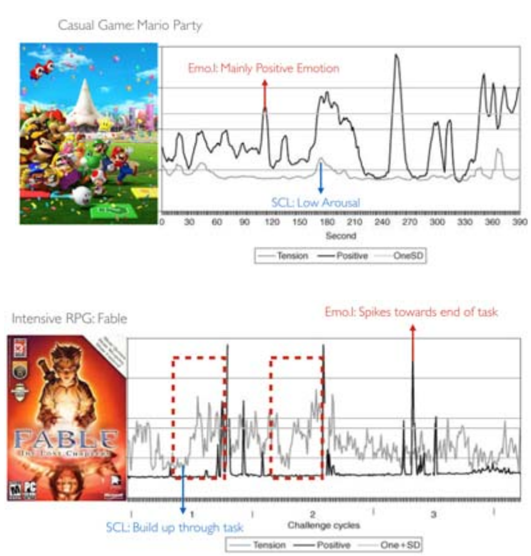
Combining Emo.I and SCL measurements provides a very powerful framework for observing and interpreting what a player is actually going through during game play. Presenting the data on a time curve makes it immediately apparent whether a player is in flow, feels frustrated, or is experiencing boredom. As the curve is plotted over time, it is possible to link the resulting emotions back to whatever is causing them. All that is needed is to review the eye tracking video recording. (See figure 7.)

FIGURE 7.



Applying this to real world examples, a typical successful role playing game (RPG) should exhibit spikes of Emo.I and gradual buildup of SCL towards the end of every challenge gamers are presented with (e.g. quests, boss battles). A good counter example is casual games, where there are primarily positive Emo.I and low / flat SCL curves. (See figure 8.)

FIGURE 8.



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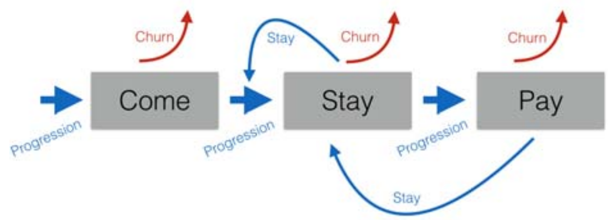
STRUCTURE OF RESULTS

The interaction of players with any game can be conceptualised as consisting of two discrete steps: come and stay. In the case of freemium games there is also a third separate step: pay (not dealt with in this paper). In the more traditional pay-first game sales model this can be included in, or before, the come stage. This conceptualisation of the gaming process elucidates a few crucial points.

First, from a very generalised perspective, gaming is a chronological process that consists of discrete stages of progression. The game should first aim to ease players into the game world, subsequently it should be compelling enough for them to stay, and finally convincing enough for some to even pay money for (in the case of freemium). Throwing players directly into the deep end is likely to be discouraging and lead to premature churn. Player progression through the stages should be a consciously managed and sequential process.

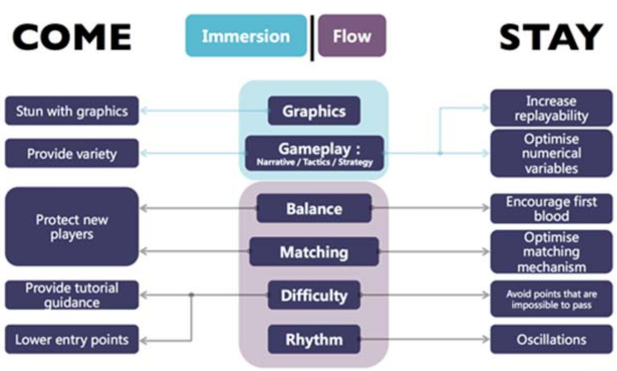
Second, as the objectives of each step vary, different game elements inevitably drive each stage. The novelty factor that attracts players in the first place always wears off with time as they delve deeper into a game. It is important to monitor when and how a player progresses from one stage to the other. Intervening in the appropriate places helps avoid churn and guides the player through the stages of the game. (See figure 9.)

FIGURE 9.



Third, as the objectives of each stage are different (attraction vs retention), the game elements that drive each stage are inevitably different. For example, whereas attractive graphics may draw new players into the game world (come stage), there need to be other compelling reasons for players to stay on (stay stage) such as rhythm. (See figure 10.)

FIGURE 10.



RESULT I: WHAT ATTRACTS PLAYERS TO GAMES?

The first stage in the gaming experience is to attract players to try the game. This paper found that the emotions of players in this stage are largely driven by five elements: graphics and gameplay (immersion elements); balance, matching systems, and difficulty (flow elements). Rhythm does not play a role in this stage. Immersion is the dominant emotion in this stage.

Stunning graphics

Stunning explosions or aesthetically pleasing movements that play and reverberate across the screen are very effective at catching attention. Supporting data is shown in figure 11. The Emo.I index shows that these kinds of effects consistently draw interest from new players. Middle and high level players, most likely on account of the fact that they have previously delved deeper into game worlds, are not particularly impressed. However, such visual stimuli can draw new players into a game in the first place.

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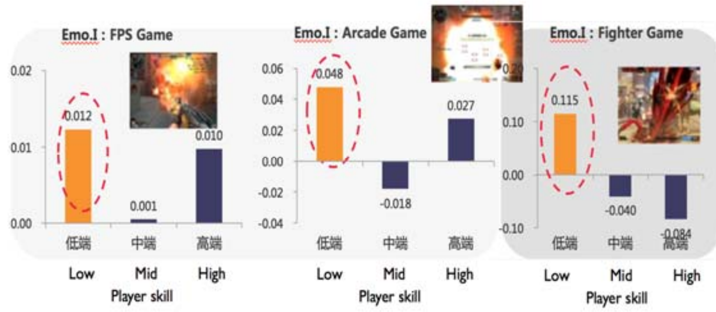
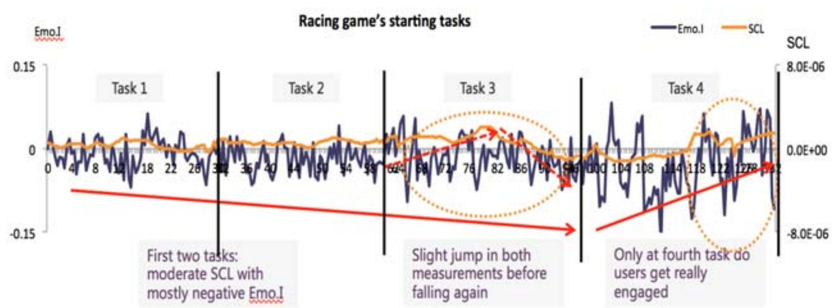
FIGURE 11.



Varied gameplay

Right from the outset gameplay needs to demonstrate to players that it can be varied and hence engaging. In figure 12, the beginning of a game is split up into four separate and sequential tasks. The immediate problem picked up by the playability test model is that the first three scenes are repetitive. Stage one and stage two both record falling Emo.I and SCL. Scene three records a slight spike before leading to disengagement again. It is only in task four that the player experiences rising Emo.I and SCL throughout. As such, the opening tasks or scenes of this particular game are a false start. The initial tasks are not engaging but boring. Tasks one through three leave plenty of opportunity for premature churn. To improve this particular game, it would be best to either adjust the first three scenes to increase engagement or make task four the opening task, scrapping the first three altogether.

FIGURE 12.

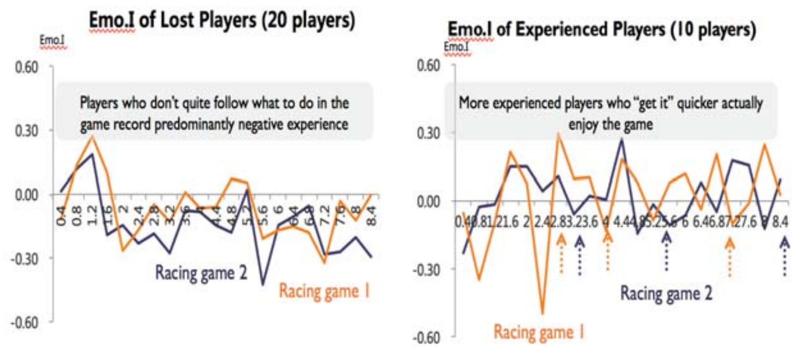


Useful beginner tutorials

Tutorials are essential for easing players into the game world. Without a supportive environment, lower level players get lost and emotionally drop out of the game. In the games tested by this paper, up to 60% of players could be categorised as prone to dropping out due to lack of guidance. Rectifying the situation with an appropriate tutorial, or at least pointers in the right places would avoid churn.

The two graphs in figure 13 depict the Emo.I of two sets of players playing two separate games. The graph on the left shows how low level players very quickly fall below the zero value line. They simply do not pick up on the required behaviours quickly enough to succeed as the game progresses. There is little in way of instructions or guidance from the game environment as to what they are supposed to do. This stands in contrast to the graph on the right where more experienced players seem to pick up on the required behaviours quicker, in spite of the lack of guidance from the game. As such, it is not because the game is not engaging enough that some players drop off, but because there is little guidance for less capable players.

FIGURE 13.



Protection of beginner players and appropriate matching systems

Matching difficulty to the player's level is crucially important to their enjoyment of a game. Make it too hard and they get disheartened. Make it too easy and they get bored. Players need to feel that they are adequately challenged by in game tasks. At the same time these tasks need to be feasibly attainable, i.e. be within reach of skill level of the given player. A player's skill and game difficulty mismatch can only lead to unhappy players.

In figure 14, the chart on the left depicts a player that is sufficiently challenged by the game. Interest and emotional engagement is maintained throughout. On the other hand, the chart on the right depicts a player that is out of his depth and is struggling to keep up.

FIGURE 14.

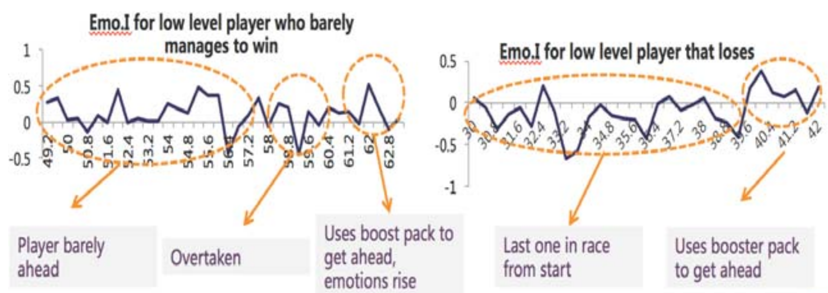
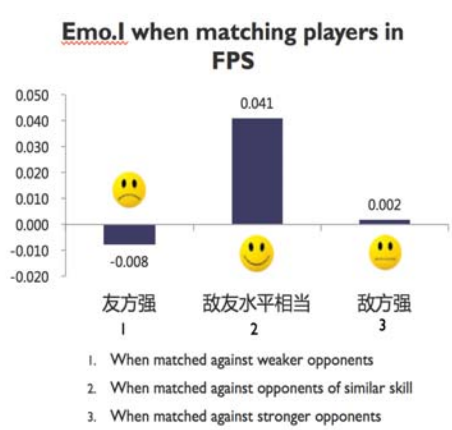


Figure 15 depicts player Emo.I responses to the skill level of their opponents. There are three scenarios. First, when a player's team is matched against another of a lower skill level, Emo.I is negative (left bar). Nobody wants to play against weaker opponents. There is no fun in that. Second, when matched against a team of comparable skill, Emo.I is high (middle bar). Third, when the opposing team is too strong, the challenge is too high to surmount and Emo.I is near zero (right bar).

FIGURE 15.

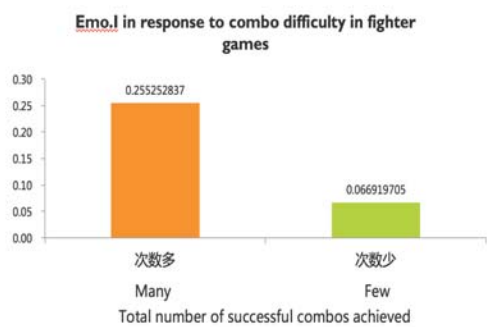


Lower entry level in harder games
Games with high requirements on player skills from the outset tend to lose players. While there is nothing wrong with games that have steep learning curves, if the learning curve starts from too high a level in the first place, it can easily alienate newcomers. Lowering the entry bar for new players would enable more gamers to try and continue on with the game, rather than just serve a set of already advanced players.

This point is different from the one about the need for tutorials. Whereas tutorials provide guidance for new players and bring them up to speed about what they are expected to do in the game world, games without entry level modes would be difficult to master even with tutorials. Tutorials can provide guidance but they do not lower the game's difficulty per se. They provide understanding of the core gameplay. However, if the core gameplay is difficult to master in itself, simply understanding it without being able to master it will keep the game out of reach for many players.

Figure 16 depicts player Emo.I for two fighter games. The orange bar on the left shows results for where the mechanic for building combos (combining simple attacks into a more powerful sequence) is relatively easy to master. Players are happy when they manage to pull a string of combos together. On the other hand, the green bar on the right indicates a fighter game where linking attacks into a combo is mechanically too difficult. Pressing the right sequence of buttons and the timings are too difficult to follow or remember. Tutorials would not help here. The mechanics need to be simplified.

FIGURE 16.



Section conclusion
Different levels of players react differently when first engaging with a game. While middle and high level players may be largely left alone, new players need greater attention and assistance. A relatively greater emphasis needs to be placed on easing new players into the game world. First, epic graphics visually draw them in. Second, varied gameplay in the very first few tasks should illustrate how rich the world they are entering really is. Third, tutorials should assist in creating understanding of the required behaviours. Fourth, matching systems should strike a balance between difficulty and player skill to induce positive emotions. Fifth, games with complicated mechanics should aim to simplify them.

As such, there are two crucial takeaways from this section. First, it is important that a game can identify and classify player skill levels quickly and efficiently. Not every player is the same. Second, the difficulty level and degree of assistance need to be matched accordingly to player classification. If done correctly, a game will then be able to meet the emotional needs of all its players. This should be done by lowering difficulty for new players, while raising it for more experienced players, thereby edging both player types into a state of immersion and flow.

RESULT II: WHAT MAKES GAMERS STAY IN THE GAME WORLD?

The second stage in the gaming experience is to retain players in the game. This paper found that the emotions of players in this stage are largely driven by six elements: gameplay (immersion element); balance, matching system, difficulty, and rhythm or pace (flow elements). Graphics are not as relevant in this stage. Flow is the dominant emotion in this stage.

Increasing replayability
As a player spends more time with a game, the novelty factor wears off. The graph below depicts results for high level gamers playing two endless runner games. The characteristic below baseline Emo.I and low to negative SCL indicate player boredom. By now players have played the map levels of the games a number of times and actually find it tiresome to continue playing repeatedly. Designing map levels that are more amenable to replayability would help retain player interest. (See figure 17.)

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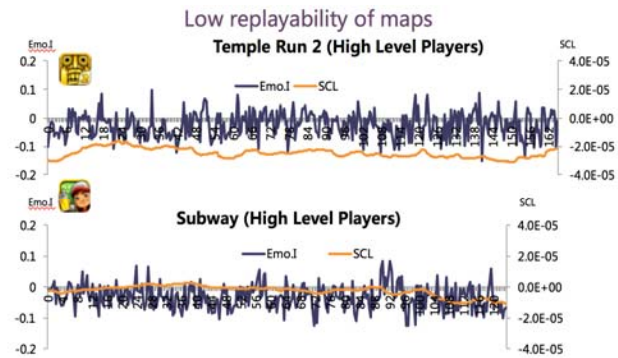
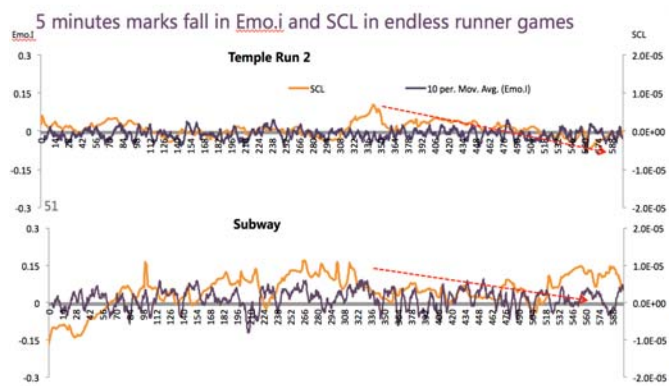
FIGURE 17.



Adjusting numerical variables

An interesting finding is that merely adjusting the numerical values of certain variables, as opposed to redesigning whole elements (e.g. maps, visuals), a game can significantly improve its performance. For example, this paper found that no matter how one designs map levels or props (e.g. power ups), players start losing interest in endless runner games around the five minute mark (300 seconds in the graphs below). As such, designing a game to end around this point, either through increasing difficulty above player skill or by other means, would leave players with a good feeling, wanting to have another go rather than being literally bored to death. (See figure 18.)

FIGURE 18.



Another example of a simple numerical adjustment that has a disproportionate impact on a game is the size of the headshot box in first person shooter games (FPS). Player sessions in the client's self developed FPS were half the duration of the genre's leader. This remained unchanged for two years, despite numerous updates. The neuroscience study found that the reason was that the headshot rate in the client's FPS was twice as high as the genre's average. The ease of quick kills was just not making the matches thrilling enough for players to play more. The avatar headshot box was too large. After minimising it, the matches gained popularity, with gamers playing more matches than before.

Incentivising first blood

In player versus player (PvP) games, such as fighter games, a common observation is that players actually avoid initiating contact. As seen in figure 19, there would be stretches of time when fighters would dance around each other without ever engaging. Players perceived that first movers were actually at a disadvantage and "turtling" (standing in one place in defensive position) was prevalent. While beneficial to the turtling player, this behaviour is detrimental to the enjoyment of the game for both players. As such, a game should encourage players to engage first. This can be done by rewarding first movers with "first blood" bonus points or similar mechanisms.

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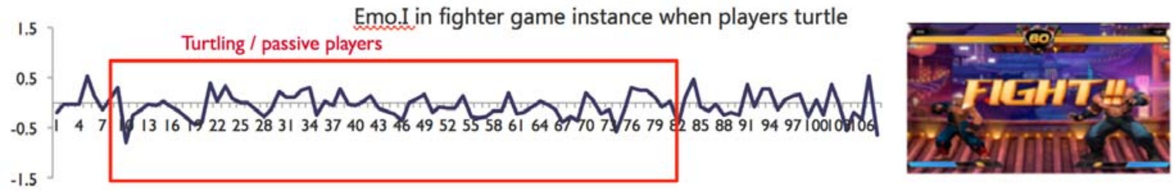
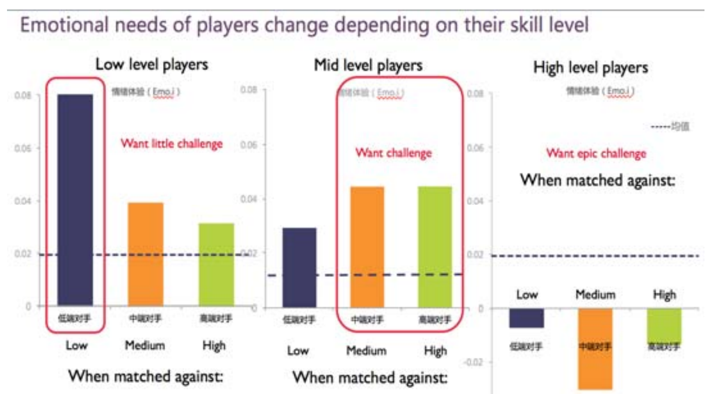
FIGURE 19.



Optimising matching systems to provide challenges

The emotional needs of players vary according to their skill level. As seen from figure 20, low level players respond with high Emo.I when matched against other low level players. They will take on the challenge of battling higher level players if matched against them but their enthusiasm is significantly curbed. For middle level players, being matched against similar or higher level players yields the same positive levels of emotional reaction. The emotional reaction is more positive than when matched against lower level players. As for high level players, they may seem like malcontents (Emo.I negative in all scenarios), but what they really crave is simply an epic challenge that would really make them work for the reward of winning. As such, a game needs to be able to identify player skill level and match them against appropriate opponents.

FIGURE 20.

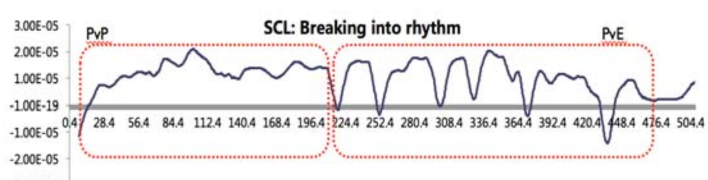


Rhythm

Once steeped in the game world, rhythm is an important factor in retaining players. Figure 21 depicts a player's SCL (biometrically measured arousal) over the course of about eight minutes. During the first 224 seconds (just under four minutes), the participant plays against a live opponent (PvP), where a very high SCL level is recorded and maintained. While a buildup of SCL is very desirable in a game, ideally it should subside after every task or match conclusion. In this case, however, player anxiety was maintained throughout a long period of time, which is very emotionally draining and stressful.

Normally at this point, players would be too tired to continue playing and would terminate the game session. The game developer of this particular title unsuccessfully tried on to induce a more oscillating pattern of SCL through various design changes to the game. However, no matter what was tried, it seemed that within the PvP mode, it was impossible to break up SCL build up. In the end, the solution that worked, and which could be credited with the lengthening of the duration of player sessions, was the introduction of a new game mode: Player versus Environment (PvE). In figure 22 it can be seen that players naturally default to the PvE mode (224s-426s) after a few matches in the PvP mode (0s-224s). The new mode gives players the opportunity to cool off and fall back into the oscillating pattern that helps retain them in the game for longer.

FIGURE 21.



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Section conclusion

The objectives of the come and stay stages are different. For the former it is attraction, for the former, it is retention. As such, it is perhaps unsurprising that the drivers of the stay stage are different to those of the come stage. Whereas the come stage was mostly about attracting players visually with graphics and then easing them into the game world through introduction mechanisms – such as tutorials, lower entry difficulties, and varied outset gameplay – the stay stage is driven by retention mechanisms, such as replayability, optimising numerical variables, providing appropriately difficult challenges, and rhythm.

CONCLUDING REMARKS

The paper presented the results from a neuroscience playability test model pilot for games. Its contributions are twofold. First, the paper demonstrates that emotions can be successfully identified and quantified during gameplay. In doing so, it has finally linked game elements with flow and immersion related emotions. It has done so using objective, continuous, and quantifiable data. Linkages between cause and effect are now clearly visible.

Second, the paper demonstrates that the data so collected provides clear and useful insights. Player emotions are no longer a black box. They are now capable of being isolated, quantified, and documented. As such, game elements can be adjusted to optimise for immersion and flow theory emotions. Get the emotions right and you get the game right. The testing model can provide feedback to tackle previously difficult questions such as:

Flow theory game elements:

- Opponent matching system: e.g. do players feel challenged enough when matched against certain levels of opponents? How does it influence player experience? How can it be improved?
- In game feedback systems: e.g. do players feel punished enough for dying in the game but still want to play again? Is there a mismatch between intended design and emotional effect? How can it be improved?
- Difficulty progression, e.g. does the player feel a sense of achievement when leveling up or is it too easy/difficult? How can it be improved?

Immersion theory game elements:

- What weighting players subconsciously assign to immersion elements, e.g. does background music or the visual design matter more?
- Whether these game elements vary across game genres, e.g. do visual effects matter more in combat games than strategy games?

Hopefully the paper will inspire other gaming studios to follow suit in deploying this methodology in practice for the benefit of gamers and the games industry as a whole.

In a wider context, the paper's results also have more far ranging applications. While the research design outlined above had been specifically tailored to games research, the methodology (neuroscience) and the specific measurements (SCL, Emo.I) can be useful in a variety of other contexts as well.

Essentially, the paper's working framework treats games as emotional products. Game titles are not bought for their individual features. Successful games are more than the sum of their parts. After all, at the principal level they are nothing but computer software. We play games for the emotions they engender: joy, excitement, sense of achievement, or camaraderie in multiplayer titles. That is the power of games. And that is why they are an emotional product.

As such, the paper's framework can be applied to other products that aim to engender emotions. The approach is quite industry agnostic. Specifically, research into cosmetics, automobiles, and advertising come to mind. Applications could range from product design, as done with games in this paper, through the design of the retail experience, all the way to the actual way the products are positioned in the mind of the consumer. The framework can comfortably deal with anything that is an emotionally loaded purchase decision or process.

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GLOSSARY

- EEG: Electroencephalography (EEG) is the recording of electrical activity along the scalp. EEG measures voltage fluctuations resulting from ionic current flows within the neurons of the brain. The main output measure derived from EEG in this paper is the Emo.I index.
- Eye tracking: Eye tracking is the process of measuring either the point of gaze (where one is looking) or the motion of an eye relative to the head. An eye tracker is a device for measuring eye positions and eye movement. Eye trackers are used in research on the visual system, in psychology, and in product design.
- Skin Conductance Level (SCL) or Galvanic Skin Response (GSR) is a biometric measure of skin conductance. The sweatier the skin, the higher the gamer's arousal.

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