Flow in Games

a Jenova Chen MFA Thesis

Abstract

This thesis provides a unique game design methodology to realize player-centric Dynamic Difficulty Adjustment (DDA) in video games, which creates optimized video game experiences for different types of players.

Rather than offering player a passive DDA experience by analyzing incomplete in-game data, this thesis uses Mihaly Csikszentmihalyi's Flow theory and provides players with subconscious choices to help them actively customize their optimal video game experiences. It treats active DDA as a new parameter for analyzing video games and seeks to address why certain video games had a wider appeal than others

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Introduction

“TWENTY-THREE HUNDRED YEARS AGO Aristotle concluded that, more than anything else, men and women seek happiness...”
- Mihaly Csikszentmihalyi (1990)

Motivation

In the last 30 years, as a form of entertainment, video games have evolved from confined arcade activities into a mature media. Video games have deeply infiltrated our daily life and our society.

As if toys expanded every child’s imagination, modern videogames take advantage of a player's active involvement to open more possibilities than any other existing mediums. [Wright 2006] More and more people grow up playing video games, treating them not only as an art form but also as serious media.

However, video games are still recognized by the majority, who do not play video games, as shallow and aggression-provoking materials. The difference between watching someone playing a video game, and playing a video game by yourself, is tremendous. The most efficient way to reduce bias and resistance from non-gamers is to create games they feel like playing. When a non-gamer can find a game they enjoy, they will no longer consider video games shallow.

Due to the nature of marketing and business, making video games purely for non-gamers is too risky and impractical. Game developers are looking for ways to expand the reach of their products. By taking existing intellectual properties from books or movies, making games appealing to both gamers and non-gamers is not as difficult as it seems to be. However making a game that both gamers and non-gamers can enjoy is quite a challenge.

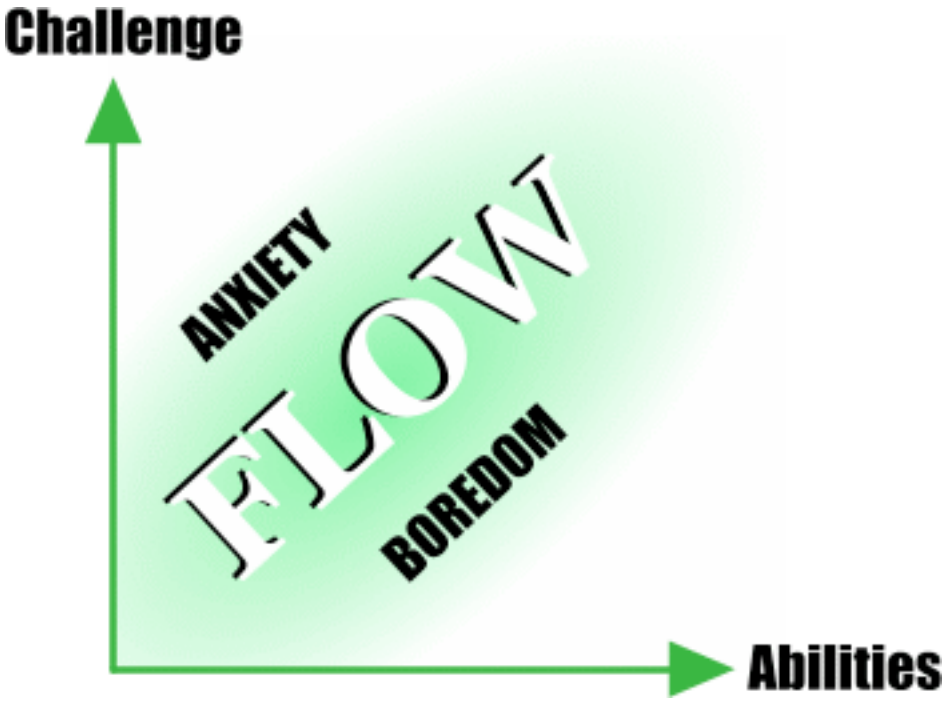
The quality and the budget of typical commercial video games today can easily reach over 20 million dollars. Ironically, because of the richness and the length of their content, most gamers can’t even finish their games today. While these games might be fine for their target audience, but are excessively boring or challenging for other gamers. Million-dollar production values are wasted at that point.

As the market of video games grows, methodologies for video games to adapt to different types of gamers, while keeping all of them engaged, are in demand for the next generation of gaming.

Inspiration

20 years ago, with an intention to explain happiness, Mihaly Csikszentmihalyi found Flow, the feeling of complete and energized focus in an activity, with a high level of enjoyment and fulfillment. [Debold 2002]

Csikszentmihalyi developed a series of theories to help people get into their Flow state. Since then, these theories have been applied to various fields for designing better human interactive experiences. One of his most inspiring achievements in these theories is the definition of the Flow Zone, also known as “the Zone” by the gamers:



In order to maintain a person's Flow experience, the activity needs to reach a balance between the challenges of the activity and the abilities of the participant. If the challenge is higher than the ability, the activity becomes overwhelming and generates anxiety. If the challenge is lower than the ability, it provokes boredom. Fortunately, human beings have tolerance, there is a fuzzy safe zone where the activity is not too challenging or too boring, and psychic entropies like anxiety and boredom would not occur. [Csikszentmihalyi 1990]

Due to the special relationship between challenge and ability, Flow has been used in fields like sports and tutoring. The famous GRE test is a good example of design based on the concept of the Flow Zone.

The description of Flow is identical to what a player experiences when totally immersed in a video game. During this experience, the player loses track of time and forgets all external pressures. It is obvious that gamers value video games based on whether or not those games can provide Flow experiences. [Holt 2000]

Thus, much research is being done about how to use Flow to evaluate video game experiences. However, there are only a few researchers out there dealing with the actual implementation of Flow inside video games.

Methodologies that help game designers to realize and maintain players' Flow experiences are not well defined.

Overview of the Thesis

The remainder of this thesis is organized into four chapters.

In Foundation – We will further explore Mihaly Csikszentmihalyi's Flow theory, introduce the concept of DDA (Dynamic Difficulty Adjustment), and check out existing research and methodologies about DDA

In Design Flow in Games – We are going to discuss the in-depth methodology about implementing Flow and player-oriented DDA inside video game.

In Implement Flow in Games – Two games created specifically for testing player-oriented DDA and their test results are presented.

In Conclusion – We would summarize the methodology, review the next research step, and look at possible application beyond video games.

Summary of the Contribution

The goal for Jenova Chen's MFA thesis research is to explore and develop different design techniques to enhance the Flow experience in video games. It includes general Flow design theories & processes, analysis of the existing games' Flow designs and examples of how to implement Flow with these techniques.

The contributions of this thesis, with respect to this goal, include:

- A recap of Mihaly Csikszentmihalyi's Flow theory from a game design perspective
- An overview of the current generation system-oriented DDA research and techniques
- Reinvent DDA with user/player-oriented concept
- Two new games which embody the player-oriented DDA including a discussion of the inner workings of each
- An overview of further directions and unexplored avenues for future research in the domain of achieving Flow through video game design

Foundation

Flow as Fun

People associate many feelings with “fun”, the sense of timelessness, of being at one, of exhilaration, focus, immediacy. All of these are characteristic of "fun".

There is a universal agreement that without a dynamic balance between the challenge of an activity and the ability to meet that challenge, fun is something we are definitely not having. Interestingly, making it possible for anyone to find exactly the right amount of challenge to engage with the exact abilities is the only way to access Flow. This means that when work is fun we have created complex, but negotiable challenges, challenges that allow the individual to engage or disengage, to work harder or work safer. [Dekoven DeepFun.com]

At this point, fun can be defined as Flow, a balance of the relationship between challenge and ability.

Elements of Flow

According to Mihaly Csikszentmihalyi's well-documented research and wide-scale gathering of personal observations, the phenomenology of Flow has eight major components.

1. A challenge activity that requires skills
2. The merging of action and awareness
3. Clear goals
4. Direct feedback
5. Concentration on the task at hand
6. The sense of control
7. The loss of self-consciousness
8. The transformation of time

Not all of these components are needed for flow to be experienced. [Csikszentmihalyi 1990]

Once we have digested the above components and revisited them with a game design perspective, here are the three core elements a video game must have in order to evoke Flow experience.

1. As a premise, the game is intrinsically rewarding, and the player is up to play the game.
2. The game offers right amount of challenges to match with the player’s ability, which allows him/her to delve deeply into the game.
3. The player needs to feel a sense of personal control over the game activity.

As a result, the game will make player lose track of time and self-consciousness.

To make a game that different people can enjoy, the game itself must retain these four elements, especially to adjust the challenge based on each player's ability.

Dynamic Difficulty Adjustment

Dynamic Difficulty Adjustment, also known as DDA, is a fairly straightforward and ideal concept in the game design field. The difficulty of a game should change dynamically based on its player's skill and performance.

However, designing and implementing a DDA system is not trivial. Every so often, DDA systems take control away from the game designers, which potentially causes more problems than a linear game. Few commercial developers have implemented DDA systems for their games, and even fewer have shipped them. [Arey & Wells 2001]

Over all DDA is just part of the core elements of Flow, it cannot stand-alone and reach Flow by itself. Rather than focusing on designing a DDA system for games, designing a general Flow system based on all core elements will be more direct and useful for the game designers

Design Flow in Games

Video games as a media can be reviewed as two essential components:

Game Content - The soul of a video game; a specific experience the game is designed to convey

Game System - The body of a video game; an interactive software that communicates Game Content to the players through visuals, audio and interactions

When treated as content, the definition of Flow is too broad. However, if applied properly, it can literally happen in every game. In order to make a game special, it requires content that is more sophisticated than Flow experiences.

But when treated as a system Flow explains why people prefer certain games more than other games and how they become addicted towards these games. If a game meets all the core elements of Flow, any content could become rewarding, any premise might become engaging. [Sweetser & Wyeth 2005]

From the simplicity of Tetris to the complexity of Civilization IV, video games have already proven to the world that anything can be fun if players can access Flow.

Expand the Flow Zone

Assume the content is attractive to the audience. Designing a video game is very much about how to keep the player in the Flow and eventually be able to finish the game. Therefore, the game system needs to maintain different players' experiences inside the Flow Zone.

In Figure 2, the red curve represents an actual experience a player gained through playing one segment of a video game. The player may feel a certain part of the game experience is a little bit harder or easier than their expectation. But he can still tolerate and maintain his Flow experience inside the safe zone.

If the actual experience gets too far away from the Flow zone, the negative psychic entropy like anxiety and boredom will break player’s Flow experience. See Figure 3.

Unfortunately, like fingerprints, different people have different skills and Flow Zones. A well-designed game might keep normal players in Flow, but will not be as effective for hardcore or novice players. See Figure 4.

For example, a simple action to an FPS player such as shooting, might be an extremely difficult task for a casual gamer just starting a game. Even though the rest of the game might be something that casual gamers enjoy a lot, the harsh beginning just turns them off.

In order to design a game for broader audiences, the in-game experience can’t be linear and static. Instead, it needs to offer a wide coverage of potential experiences to fit in different players’ Flow Zones.

To expand a game's Flow Zone coverage, the design needs to offer a wide variety of gameplay experiences. From extremely simple tasks to complex problem solving, different

players should always be able to find the right amount of challenges to engage during the Flow experience. These options of different gameplay experiences need to be obvious, so that when players first start the game they can easily identify the corresponding gameplay experience and delve into it.

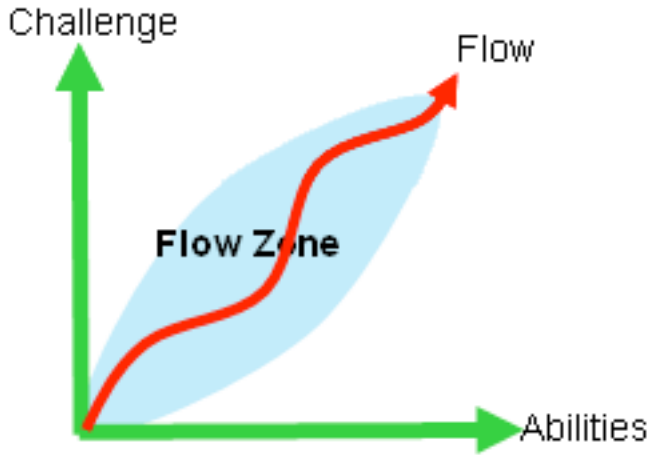


Figure 2 Player in-game Flow experience

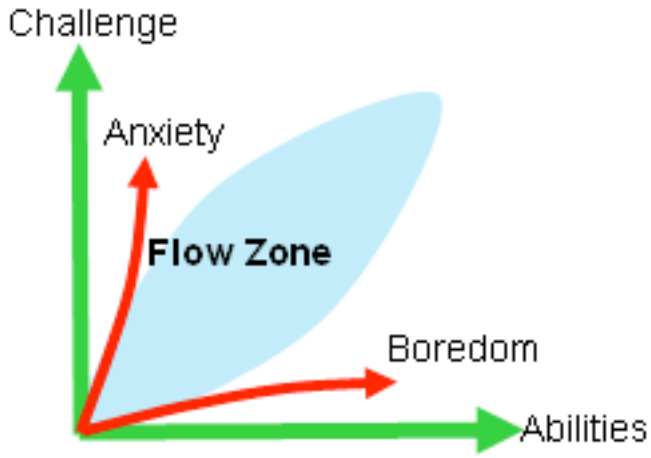


Figure 3 Player encounters psychic entropies

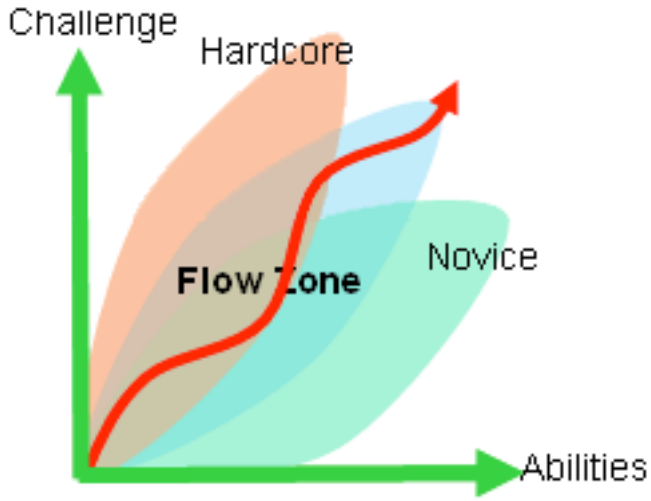


Figure 4 Different players and Flow Zones

Create Dynamic Flow

Game Tuning & Static Flow

Every so often, gamers describe an engaging game experience as "Well tuned". Tuning represents the process of a game designer using playtesting to iterate the design and manually polish the game experience until it gets close to evoking Flow. However, as the video game market expands, game tuning based on playtesting cannot satisfy the mass audience any more.

Playtesting usually involves multiple testers to reveal the potential Flow entropies in the game. On one hand, these entropies can be obvious at a micro level e.g. crashes, typos, texture flaws and bad dialogs. On the other hand, from a macro level, flaws inside core mechanics, plot arrangement, level difficulties and overall game progression are hard to identify. Today's playtesting is also very discontinuous. Each tester is in charge of different segments of the game. Without a view of the big pictures, Flows at the macro level are never really tested.

Game tuning also indicates the rigidity and linearity of the final game experience. The experience is adjusted for the specific testers and designers who cannot represent the variety of the mass audience. Flows in these games are very static. They can’t adapt to different types of gamers.

In order to realize optimal experiences for a much wider audience, not only do we need to offer a wide Flow Zone coverage, we also need a highly adaptive system to weave the rich gameplay experiences together, adjusting Flow experiences based on the players.

Passive Flow Adjustment

The biggest dilemma on Flow adjustment is whether or not to create a system to adjust the gameplay for the player. Under this kind of passive system, players can enjoy the Flow experience fed by the system.

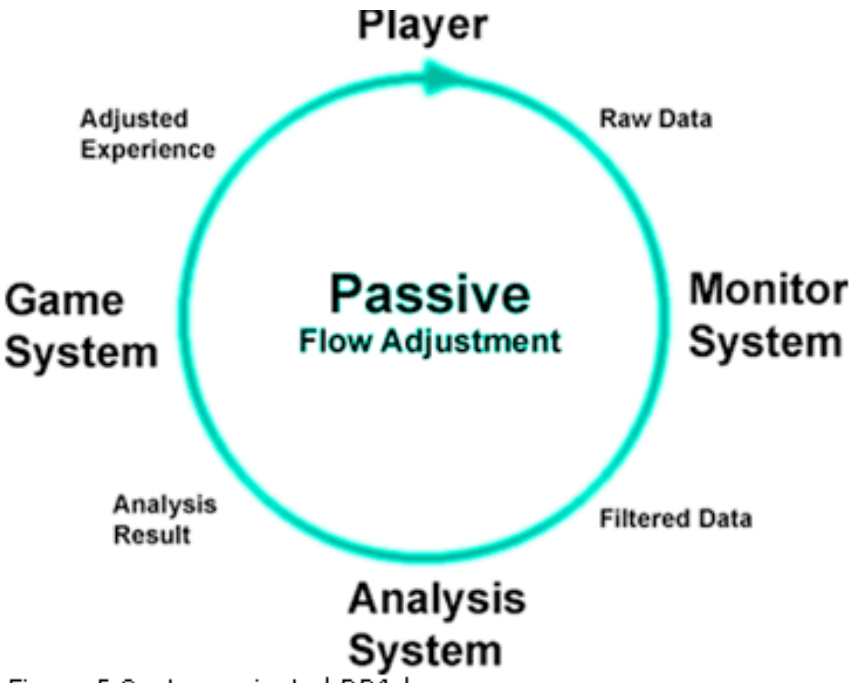


Figure 5 System-oriented DDA loop

Much research centers around designing a system that adjusts the difficulty based on the player's performance. This kind of system-oriented DDA works under an iterative adjusting loop.

The loop consists of four fundamental elements:

1. Player - Create raw data inside the game through playing
2. Monitor System - Choose critical data reflecting player's Flow state and pass it over Analysis System.
3. Analysis System - Analyze player's Flow state and notify the Game System about what needs to be changed
4. Game System - Apply changes to the gameplay based on the request from Analysis System

Theoretically, this system should be able to maintain player's Flow by constantly reacting to the feedback collected from him. [Bailey & Katchabaw 2005] However, there are still several key unsolved problems , which makes this type of passive flow adjustment hard to implement.

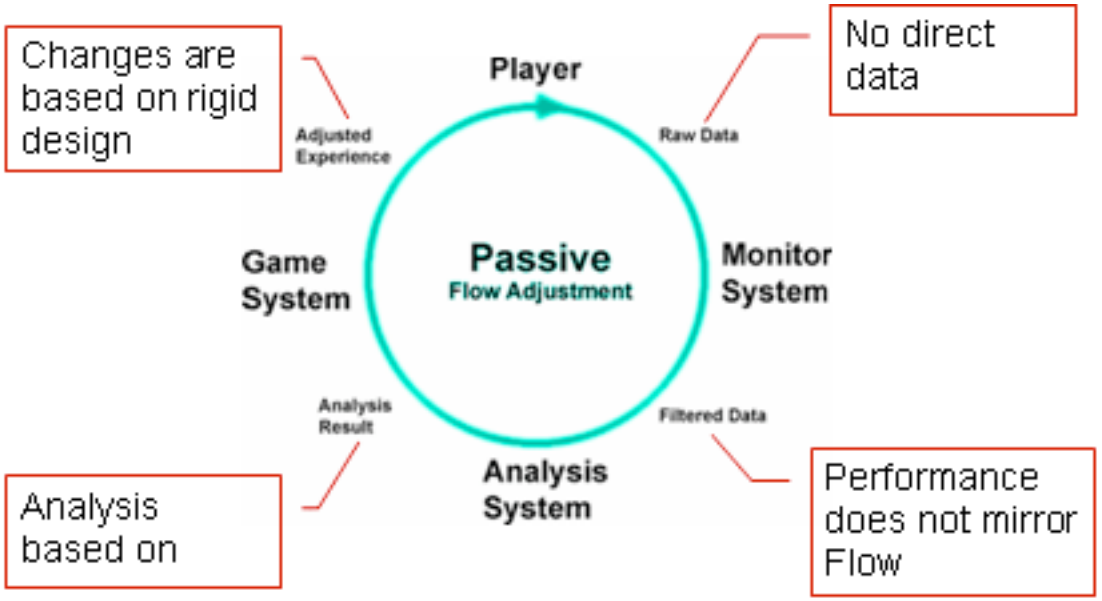


Figure 6 Issues inside System-oriented Flow DDA

No direct data - Video games do not read what player thinks yet. Up until today, the most common connections between players and video games are still going through game controllers. With limited inputs, the possibility to sense player's Flow state directly is very low. Although there are biofeedback devices on the market, people still lack the knowledge for imaging data into Flow and emotions. Most of the measurements are still based on assumptions and incomplete statistics.

Performance does not mirror Flow - Video game designers and researchers have figured out ways to estimate player's performance through sampling limited data like “Total Kill”, “Accuracy” and “Headshot”. However, performance is objective while Flow is subjective. When a player is in the Flow of just jumping around in Super Mario Bro but not finishing any level, the DDA system will have trouble to sense that.

Analysis based on assumptions - Assumptions never work for mass audience. When a player enjoys performing a suicidal stunt in Grand Theft Auto, it would be ridiculous for a DDA system to assume that the player's skill is too poor because of the death count.

Changes are based on rigid design – The way a system adjusts its difficulty is pre-determined by the designer. Different designers use their own preferences when deciding how many changes should be applied; however, the individual preferences of a designer will never represent the preferences of a mass audience. [Costikyan 2004]

Active Flow Adjustment

Considering the core elements of Flow, most of the system-oriented DDA designs were over focused on one aspect, balancing between challenge and ability. However, they ignored the other important core element, to make player feel a sense of control over the game activity.

Mihaly Csikszentmihalyi often describes Flow as driving a small boat in parallel to the current. Being able to drive freely gifts a sense of control over micro action, and being carried by the current offers a sense of control over the macro activity, therefore evokes Flow.

In traditional passive media, like the current, the sense of control comes from the sense of progression and positive feedback. [Adams 2002] In video games, not only can players gain control from the progression, they can also earn it through driving the boat, which is in fact making meaningful choices. So why don't we give the players choices in a video game and let them navigate their Flow experience?

In order to create a game like this, as we mentioned in 4.1 Expand the Flow Zone, the game needs to offer a pool with a wide spectrum of activities and difficulties for different types of players to swim inside. Based on players' tastes, each individual will choose different choices and work at a different pace to navigate through the game.

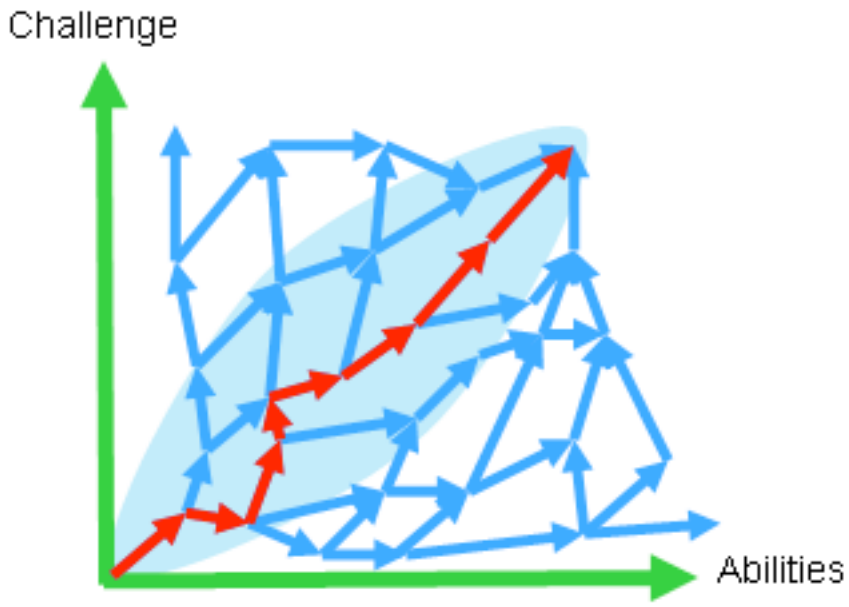


Figure 7 Active Flow Adjustment through Choices

Once a network of choices is applied, the Flow experience is very much customizable by the players. If they start feeling bored, they can choose to play harder, vice versa.

Embed Choices into Gameplay

Player-oriented DDA offers an active mechanic for players to control their in-game Flow experience. However, the implementation of these choices is not trivial.

In order to adjust Flow experiences dynamically and to reduce Flow noises, the choices have to appear in a relatively high frequency. These frequent choices might become potential interruptions for players who are in the Flow Zone.

The easy solution that might come to mind is to implement a monitor system to detect whether or not it is a good time to offer choices to the player. However, monitor systems are still not mature enough to be able to detect player's Flow. The only solution is to embed choices into the gameplay, let the player treat choices as part of the play and eventually ignore them. Thus their choices will become intuitive and reflecting their actual desires.

Conclusion

Designing game systems where a wide range of players can get into Flow is not difficult:

1. Expand your game's Flow coverage by including a wide spectrum of gameplay with different difficulties and flavors
2. Create an Player-oriented Active DDA system to allow different players to play in their own paces
3. Embed DDA choices into the core gameplay mechanics and let player make their choices through play

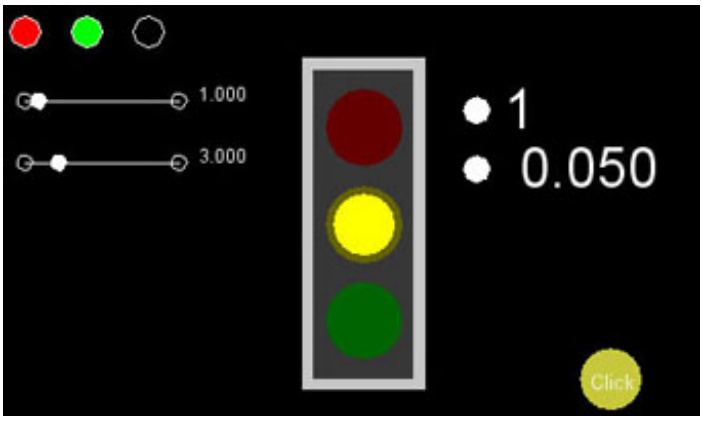
If a game designer can apply the above methodologies upon his own design, the game will become more dynamic and flexible, allowing more people to get into the Flow and finish it.

Implement Flow in Games

The best way to test out the player-oriented DDA system and methodologies is to create games designed around these methodologies and compare the result between using and not using the DDA

Traffic Light

Traffic Light is my first attempt to create a simple prototype and test whether or not player-oriented DDA helps the Flow experiences.



Overview

Traffic Light is designed to be a game with minimal interaction and a test bed for choices based DDA. The only thing a player needs to do in this game is to predict and click the button as late as they can before the red light goes on.

By default, the player has three times to try in each round. If the player won two out of the three, he can keep his total score and go to the next round. If the player failed in one round, he loses the total score.

Between each round the system will ask the player if they want to play faster or slower or stay as the current speed.

Interface

On the top left of the screen are lights representing the total times player can try in each round. If they failed it turns red, otherwise it is green. If they have not tried, it shows as black.

The two scrollbars allow players to change the speed and the total times in each round.

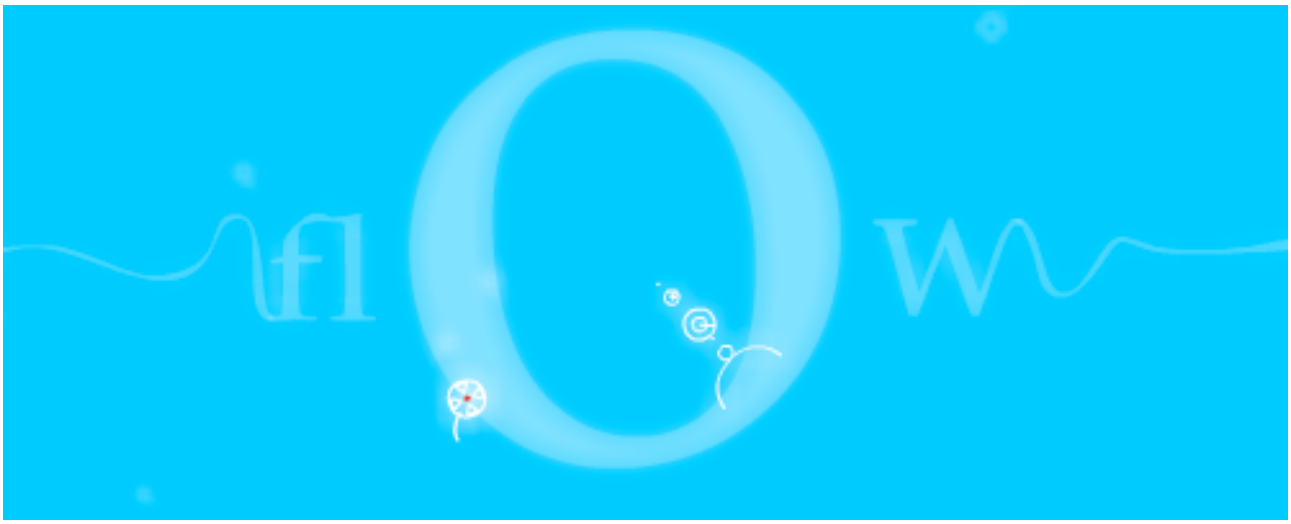
The two rows of numbers on the right represent the total score and how many seconds earlier the player clicked the button.

Test Result

Player-oriented DDA based on choices effectively extends the game Flow. It extends a simple timing game's lifespan from 1-2 minute to about 5 – 12 minutes.

However, the frequent DDA choices broke the player's Flow. It started offering the player a sense of control, but eventually reduces the player's control.

FlOw



Overview
FlOw is created to test player-oriented DDA with choices embedded inside the gameplay.

In flOw, the player uses the mouse cursor to navigate an organism through a surreal biosphere where it consumes other organisms, evolves, and advances into the abyss.

The gameplay is intentionally designed to be extremely minimal for easily evaluating the efficiency of the player-oriented DDA system. The only action players can perform is to swim around and eat other organisms in front of its mouth.

Expand Flow Coverage
FlOw uses minimal control to open the door for casual gamers and non-gamers, but still leaves space for hardcore gamers to master it. It offers a wide range of gameplay from simply swimming around and eating to strategically evolving and intensive fighting.

Adjust Flow
FlOw is divided into 20 levels. Each level introduces new creatures with new challenges. Different from traditional games in which players have to complete one level in order to progress to the next one, flOw offers player power to control their gameplay progress. By choosing different food to eat, players can advance to the more difficult level and return to the easier level at any time. The game features a minimal death penalty. If player died in one level, he will be pushed back to the previous level that is relatively easy. Player can also choose to avoid the challenge, skip the level, and come back later.

Embed DDA Choices into Gameplay
In flOw, players can customize their Flow experience naturally through the core gameplay, swimming and eating. By swimming closer to or farther away from other organisms, and eating different types of food, players subconsciously balanced their Flow experience.

Test Result
The current version of flOw is prototyped in Macromedia Flash 8. During the first two weeks after flOw was released online, it attracted more than 350,000 downloads.

“Addicting” is the most common word its fans use to describe it. FlOw was invited and presented at the annual Experimental Gameplay Workshop during the GDC 2006. It also won the Internet Game of the Month on EDGE magazine, May 2006.

To get a sense of how widely enjoyed flOw is on the Internet, here are some of the quotes from the online community:

“There must be something wrong in playing the whole morning with this evolution game… It has no guns, blood or explosions, but something kept me glued to my seat for a long, long time.
Fortunately, my critter ran out of food and I was forced to leave it there.
Look at my mutations and changes (the best I could get in 3 hours!)”
- rc.blog()

“Show some appreciation, then, by checking out the lovely, mindful Flow. Set in a clear blue monochrome sea inhabited by Euclidean cellular critters and your own slowly evolving Tinker toy paramecium, Flow sucks you in with its sinuously elegant physics and keeps you hooked on the ever so slightly yet increasingly challenging task of gobbling up your fellow sea bugs. A brick-simple, submarine Pac-Man, Flow pulls off the remarkable feat of feeling as meditative as it is addictive.”
- Zen and Art

“For some reason I can’t stop playing it. It doesn’t make much sense, since I can’t imagine why I would continue to play it, but it’s almost soothing to play. The graphics and sound are amazingly perfect. Try it out, you won’t be disappointed. Unless you think all flash games are wastes of your time.”
- Always Beta

“Beautiful, relaxing and confusing, Flow allows you to take over the evolutionary steering wheel for a scoop-equipped microbe in a shifting sea of predators and prey.
Pros:
Easy to play
Endless
Addicting and relaxing
Very atmospheric and attractive despite the extremely basic graphics

Cons:
It's addicting like the government putting something in the water supply: you're addicted but you don't know what you're addicted to.
Almost too esoteric for its own good”
- Something Awful

Conclusion

How to Realize Flow in Games

Based on Mihaly Csikszentmihalyi's positive psychology research, when a person totally focus into an activity and forget about time and pressure, he reaches the optimal experience, Flow. There are many conditions in order to reach Flow.

In the field of game design, there are three fundamental conditions:

1. As a premise, the game is intrinsically rewarding, and the player is up to play the game.
2. The game offers right amount of challenges to match with the player's ability, which allows him/her to delve deeply into the game.
3. The player needs to feel a sense of personal control over the game activity.

In order to enhance Flow experience, here are the methodologies game designers can pick up and apply to their own designs and make them enjoyable by a much broader audience.

1. Expand your game's Flow coverage by including a wide spectrum of gameplay with different difficulties and flavors
2. Create an Player-oriented Active DDA system to allow different players to play in their own paces
3. Embed DDA choices into the core gameplay mechanics and let player make their choices through play

With the proof of Traffic Light and flOw, as well as the other successful commercial games whose designs match the above methodologies, designing games enjoyable by both gamers and non-gamers is totally feasible and should be applied to help expanding video game market and essentially make video games a more mature media.

Application in Other Media

The concept of player-oriented DDA also known as active DDA is a powerful design tool applicable not only in video games.

It can be applied to nearly any fields where there are human interactions. For example, if active DDA is applied to GRE (Graduate Record Examination) test rather than its original passive DDA, here will be the changes.

1. There is no cap for the total score. Students can gain as much score as possible during the test period. Therefore, even top students can still challenge themselves every time they take test.
2. Students should be able to see scores gained through each questions and feel the joy of answering them correctly, which encourages them to do more.
3. The difficulty and the score of each question should be related. More challenge equals more reward.
4. Student should be able to sense the difficulty of each question and have the control to skip hard questions.

And you can imagine how the overall experience will change from a passive question after question based test into an active free roaming score collecting contest.

How do you use active DDA in advertising, negotiation or even in dating? Designers in any field should be able to apply these methodologies.

What's Next for Flow in Games

The Flow researches have been mainly focused on the relationship between challenge and ability, which naturally assume the interaction. However, Flow-like experiences also exist in passive media like movie, literature and music.

Games like Sims and Cloud has already proven that there are more interesting aspects in the field of Flow that are beyond challenge and ability. Thus, the soul of video games should also be able to leap far beyond challenges and conflicts.

Bibliography

- Bernie Dekoven, Of Fun and Flow, DeepFun.com, http://www.deepfun.com/funflow.htm
- Christine Bailey & Michael Katchabaw, An Experimental Testbed to Enable Auto-dynamic Difficulty in Modern Video Games, Department of Computer Science, The University of Western Ontario, London, Ontario, Canada, 2005
- Elizabeth Debold, Flow with Soul - An interview with Dr. Mihaly Csikszentmihalyi, What is Enlightment Magazine, Issue 21, 2002 http://www.wie.org/j21/csiksz.asp
- Ernest Adams, Balancing Games with Positive Feedback, Gamasutra.com, January 4, 2002 http://www.gamasutra.com/features/20020104/adams_01.htm
- Greg Costikyan, Dynamic Difficulty Adjustment, Game*Design*Art*Culture, Jan 2004 http://www.costik.com/weblog/2004_01_01_blogchive.html#107539921797922680
- Mihaly Csikszentmihalyi, Flow: the Psychology of Optimal Experience. Harper Perennial, 1990
- Penelope Sweetser & Peta Wyeth, GameFlow: A Model for Evaluating Player's Enjoyment in Games, ACM Computers in Entertainment, Vol. 3, No. 3, July 2005
- Robertson Holt, Examining Video Game Immersion as a Flow State, B.A. Thesis, Department of Psychology, Brock University, 2000
- Will Wright, Dream Machines, Wired Magazine, Issue 14.04, April 2006 http://www.wired.com/wired/archive/14.04/wright.html