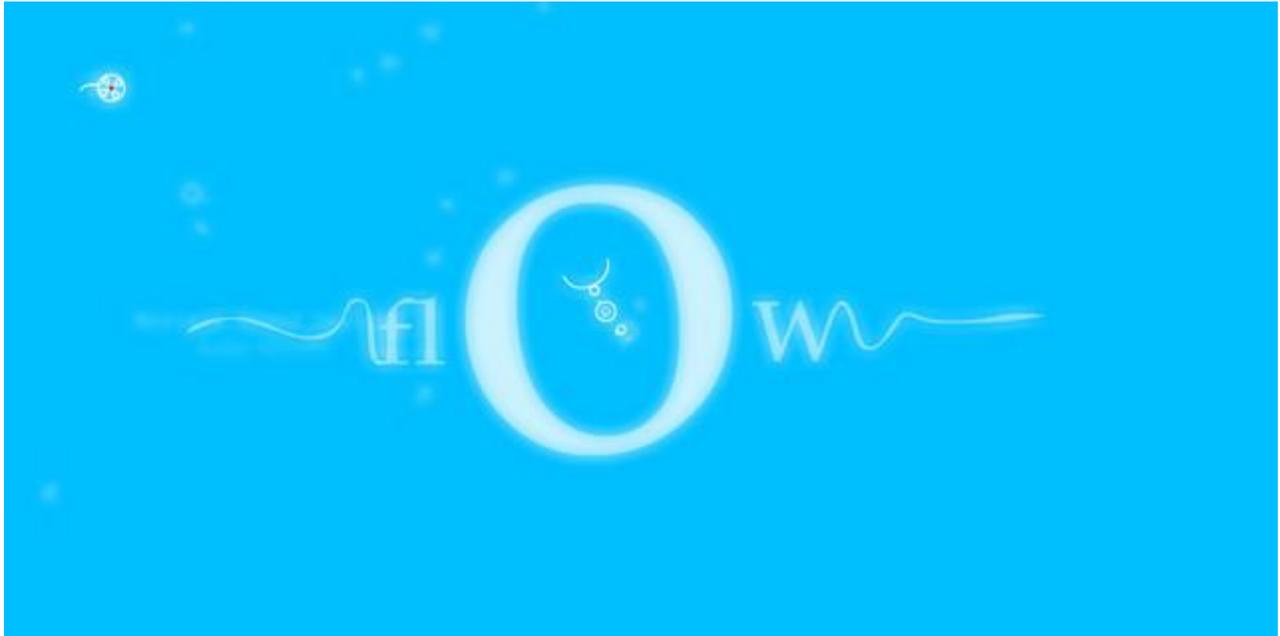
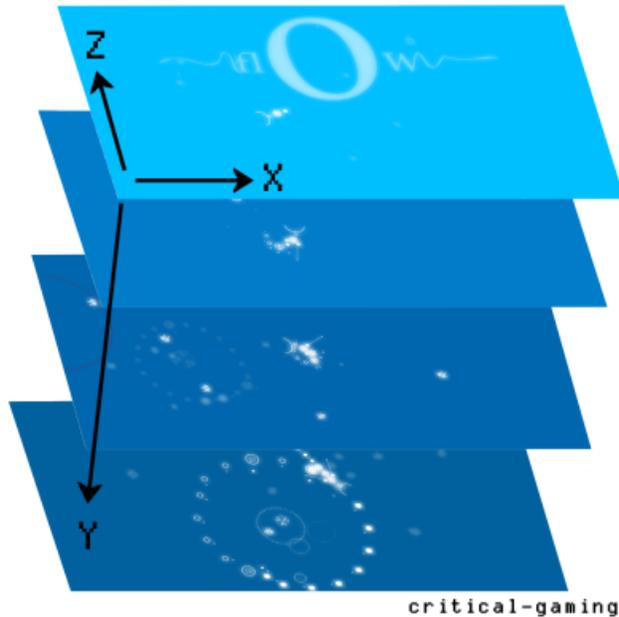


Flow and Difficulty Adjustment in Video Games

Essay by Sebastien Samson 2010



For those who have played Jenova Chen's game, FIOw, you may have noticed how easily one can become immersed in its contemplative aquatic world, fluidly floating from one prey to the next. The game is both simple and deep, with a level design based on a "sausage pattern" (Room - Gate - Room - Gate ...) similar to many games before it. It contains familiar game design elements such as enemies, power-ups, and life. So what makes FIOw such a captivating experience?



(Flow Game - Sausage Pattern Level Design)

In FLOW, players take on the role of an aquatic creature, controlled with the mouse. The goal is to eat other creatures to grow stronger. Players can choose to go deeper or return to previous rooms by eating red or blue swimming plankton. Depending on their skills, players may choose to “level up” by eating small prey, go directly to a deeper room where bigger foes await, or return to a previous room where it was safer. This simple player choice is the foundation of what Chen calls “User-Centered Dynamic Difficulty Adjustment.”

Chen bases the notion of User-Centered DDA on the theory of Optimal Experience (Flow) from Mihaly Csikszentmihalyi ¹, a well-known psychology theory that has influenced many fields such as marketing, management, pedagogy, video games, and more. One important point about flow theory is that flow is not synonymous with “fun.” Flow state can be reached in efficient and rewarding work, aesthetic experiences, and many other non-ludic activities. Chen took the main statements of Csikszentmihalyi’s theory on how to create the Optimal Experience and used them to support flow in a ludic activity:

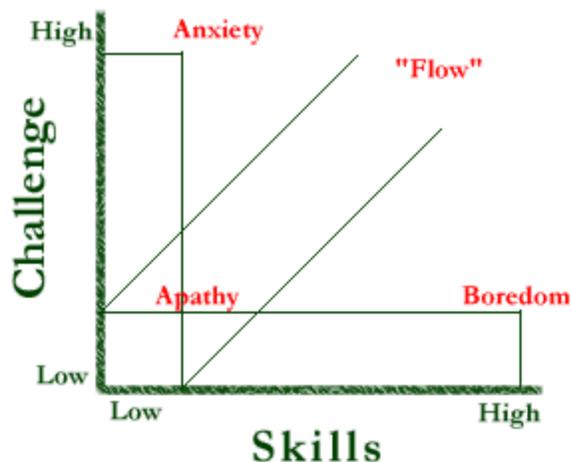
Criteria of Flow

The criteria for achieving Flow (Optimal Experience) include:

¹ Csikszentmihalyi, M. (1990). Flow: The Psychology of Optimal Experience. New York: Harper and Row. ISBN 0-06-092043-2.

- Clear goals: expectations and rules are discernible, and goals are attainable and align appropriately with one's skill set and abilities. Moreover, the challenge level and skill level should both be high.
- Concentration: a high degree of concentration on a limited field of attention, allowing the person engaged in the activity to focus and delve deeply into it.
- Loss of self-consciousness: the merging of action and awareness.
- Distorted sense of time: one's subjective experience of time is altered.
- Direct and immediate feedback: successes and failures in the course of the activity are apparent, allowing behavior to be adjusted as needed.
- Balance between ability level and challenge: the activity is neither too easy nor too difficult.
- Personal control: a sense of personal control over the situation or activity.
- Intrinsic reward: the activity is intrinsically rewarding, resulting in an effortlessness of action.
- Absorption: people become absorbed in their activity, with the focus of awareness narrowed down to the activity itself, resulting in the merging of action and awareness.

Combining these criteria may support flow experience, but as Csikszentmihalyi notes, "not all are needed for flow to be experienced."



(Flow Theory - Csikszentmihalyi)

User Centered Dynamic Difficulty Adjustment

Jenova Chen's "User-Centered DDA" is based on player choices, which corresponds to Csikszentmihalyi's criteria 6: "Balance between ability level and challenge" and criteria 7: "A sense of personal control." But Chen's FIOw game delves deeper into Csikszentmihalyi's flow theory. The game mechanics of FIOw answer more generally to criteria 1: "Clear and challenging but attainable goals." Eating and avoiding being eaten are intuitive enough goals in themselves. Criteria 5: "Direct and immediate feedback" is also met for all player actions

(moving, taking damage, eating, and changing rooms).

For video games, criteria 8 “effortlessness of action” is nearly automatic. If a player chooses to play a video game, it is generally due to intrinsic motivation (seeking entertainment), so as long as the player is not forced to play the game (which would break the definition of play as a “free activity” - CAILLOIS 2006), we can assume that there is “an effortlessness of action.” However, as we will see later, “frustration” can be one way to break criteria 8.

The other criteria (2,3,4, and 9) of the Optimal Experience can all be related to the notion of “immersion” in a broad sense. Immersion will depend on many factors such as aesthetics, context, nature of the game mechanics (required skills), topology and domain of the game, and many “non-diegetic” elements that may affect the player’s experience. These will vary greatly from one player to another.

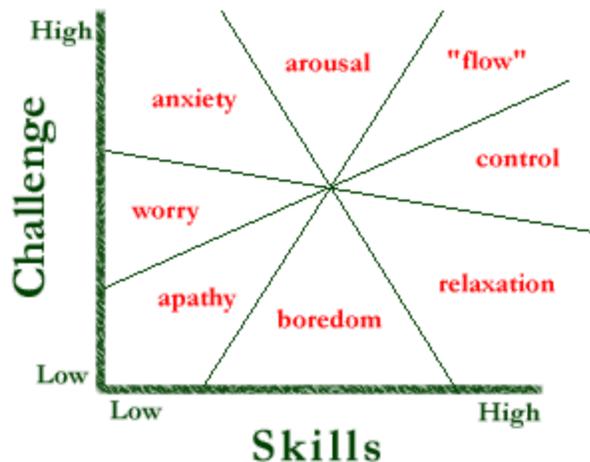
Jenova Chen’s FIOw seems to meet all of the flow experience criteria with its atmospheric aesthetics, never-ending yet well-balanced player experience based on good difficulty progression with a good learning curve, extremely simple game mechanics, and “User-Centered DDA.” However, FIOw is not the only game offering Dynamic Difficulty Adjustment. The concept has been around for a while now but is not always “User-Centered.”



(World Of Warcraft - "Grinding" in RPGs is "User Centered" DDA)

The main difference between “User-Centered DDA” and common DDA is that with User-Centered DDA, the player has a stronger “sense of control” and can gauge the “balance between ability level and challenge” (criteria 6) by themselves. Other game types use this simple but effective mechanic. For example, the “Leveling-Up” system in RPGs is based on the same principle of “User Choice.” The player chooses when to level up and when to move to a

new location to face stronger enemies. Other types of games allow the player to choose their own course and navigate freely between different challenges. By letting the player choose which challenge to try out and allowing them to do so safely (without major frustrations), the game gives the player the chance to discover their limits and improve at their own pace.



(Flow Theory - Csikszentmihalyi)

Fixed Difficulty Curve

A good learning curve should provide the player with the necessary mastery to overcome increasing challenges. In many old-style games, when the player fails, they must restart at the beginning of the level and redo the already mastered parts to get back to a good challenge and improve. This type of Difficulty Adjustment may lead to a flow state in certain ways.

In a game like Super Mario Bros, the difficulty curve is fixed (except for secret passages, of course). The player has no choice but to move forward and overcome presented challenges. Criteria 1, 2, 3, 4, 5, 8, and 9 seem possible as long as the player's skills fit the challenges (criteria 6), but dying will break immersion, causing the player to lose focus, regain self-consciousness and their sense of time, and lose the balance between skills and challenge, thus breaking their feeling of personal control over the situation. Criteria 1, 5, 8, and 9 will still be respected, and as Csikszentmihalyi noted: "not all are needed for flow to be experienced."

On the other hand, the will to restart after dying will depend on the motivation of the player. If the frustration of dying is too strong, the player will likely stop playing and recovery of the flow state will be impossible. Failing to overcome the same challenge

many times will lead to frustration and eventually apathy. As Desert Hat notes ² in his article: “...you can’t simply drop back into a flow state if the player is frustrated,” you have to bring the player back to the boredom level where they feel safe and increase the challenge again until it is optimal and can be overcome. Balancing a good difficulty curve is a very delicate job, which is why Dynamic Difficulty Adjustment has been at the center of attention for many game developers.



(Super Mario Bros - fixed difficulty curve)

Dynamic Difficulty Adjustment

The idea of DDA is highly compatible with flow theory, as the challenge level of the game is constantly adjusted based on direct feedback from the player’s performance. The main issue with such a system is the difficulty pattern followed by the DDA Artificial Intelligence. Adam Saltsman ³ gives some examples of DDA in games like Mario Kart and Left for Dead, which implemented two different strategies of DDA.

Mario Kart follows the “Rubber Band” pattern, where opponents follow the player’s performance. The downside of this strategy is that the player loses their “sense of personal control” (criteria 7) because opponents will slow down if the player falls too far behind and catch up if the player is

² Deserthat. (2009, November 26). Game Design: The Miyamoto Way – Flow and Difficulty. Retrieved from <https://deserthat.wordpress.com/2009/11/26/game-design-the-miyamoto-way-flow-and-difficulty/>

³ Saltsman, A. (2009, May 7). Game Changers: Dynamic Difficulty. Retrieved from <https://www.gamedeveloper.com/design/game-changers-dynamic-difficulty>

in first place, making the player's efforts seem seamless. This computer trick can break flow if it becomes too obvious and draws attention to itself rather than keeping the player "concentrated" (criteria 2) and "merged with their actions" (criteria 3 and 9). Additionally, the feeling of "unfairness" makes the goal of the game less clear (criteria 1) and attractive since the player has no other reference for their performance than their opponents. That said, for casual players, this trick may work for a while and provide a fair amount of enjoyment to the appropriate target audience.



(Mario Kart 64 - DDA)

On the other hand, Left for Dead adjusts the difficulty by playing with the number of enemies, pacing (respawn time), and pickup items (health, weapons, ammo). Since the narrative setting of this multiplayer first-person shooter is a zombie apocalypse, the idea of constantly being in trouble is consistent with the game's universe. The DDA system does not draw attention to itself and allows the player to remain in a state of flow even when they die (unlike a fixed difficulty curve would have done), as long as the player has the motivation to continue. The difficulty curve is tightly tuned so that the player always faces a good amount of challenges from the computer. The target audience of Left for Dead differs greatly from that of Mario Kart, and the difficulty level feels appropriate and competitive while still being adaptive behind the scenes. However, one thing this DDA system does not support is teamwork. The game is presented as an experience for a team of four players, and flow state may be broken by uncooperative teammates. In this case, criteria 7 "sense of personal control" may be a flow breaker if it is flawed by dysfunctional teamwork.



(left 4 dead - DDA)

DDA vs User Centered DDA

We can loop back to the notion of flow and “User-Centered DDA.” As we have seen earlier, “not all [criteria] are needed for flow to be experienced.” However, some criteria, such as criteria 6: “Balance between ability level and challenge” and criteria 7: “A sense of personal control over the situation or activity,” may be serious flow breakers in video games using fixed difficulty curves or DDA. The main advantage of “User-Centered DDA” is that it allows the player to control their own experience and follow their own difficulty curve without major frustrations towards the game. Again, tight tuning of the challenge is necessary to maintain the flow state. Games like Jenova Chen’s FIOw exploit user choice and present the player with a well-paced difficulty curve that can be made easier by “leveling up” or harder by doing it the “hard way” and racing to the bottom to face a disproportionate enemy.

Finally, User-Centered DDA in FIOw is possible due to the absence of time constraints. Since the player has no imperative to move forward (such as a time countdown), it creates a feeling of “free play” (paidia - CAILLOIS), which contrasts with criteria 1: “Clear Goals.” At the beginning of this article, I stated that “Eating and avoiding being eaten are intuitive enough goals in themselves,” but the player could always stay in the first levels and avoid being eaten, enjoying swimming and eating small plankton. The reason they will continue to the next level is due to intrinsic motivation driven by the autotelic nature of video games: having fun.