Designing Digital Tools for Patient Engagement
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Engagement, or a lack of it, is often identified as a key problem in the healthcare system. Patients don’t follow through with their discharge instructions; educational materials go unread; digital applications that have proven utility are opened once, and then never again. It seems to make intuitive sense that patients should care more about, and find it easier to stay engaged with applications that are essential to their health. Why, then, do patients engage more often, more consistently, and for longer, with applications and activities that promise only distraction than with mobile health tools and programs? What, if anything, can we learn from this seemingly counter-intuitive behavior that can help us design for better engagement in healthcare?

Game Psychology ≠ Video Games. While the goals of the healthcare system are obviously different from the game industry, we have seen across many projects over the past four years that healthcare applications can find measurable improvements

The goal is to support and strengthen patients’ determinations of their healthcare needs and self-care efforts with a view to obtaining maximum value and improved health outcomes. If patients are to play a more effective role they must be better supported, be better informed, be more discriminating about the effects of medical treatment, and have more opportunities for participation.


1 Hibbard, Judith H., and Jessica Greene. “What the evidence shows about patient activation: better health outcomes and care experiences; fewer data on costs.” Health affairs 32.2 (2013): 207-214


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in engagement through the application of design patterns that have traditionally been used in games: implicit and explicit goals, discoverability, compulsion loops, progression curves, competition, cooperation, variable rewards, etc.

This is the language of game design and we use it to evoke a variety of mental states that can keep a patient engaged in the process of overcoming the challenges faced during their struggle with their condition, whatever that may be.

**In this white paper we'll discuss:** understanding patient behavior through the lens of game psychology; the neurochemical basis of digital engagement; what we can learn from early, less-successful attempts at “gamification”; how we move to a more comprehensive understanding of “playful design”; and how to utilize design patterns from various styles of play using ACUDO - Ayogo’s contribution towards providing a more comprehensive approach to gamification.
Mark Twain once said that “work consists of whatever a body is obliged to do, and ... play consists of whatever a body is not obliged to do.” This is a surprisingly useful definition for us, because as it turns out, being healthy, adhering to our care plans, and/or taking our medications as instructed is not something we are obliged to do. Perhaps we should stop treating it (solely) as work, and see how far we get when we think of it (at least in part) as a kind of play.

The urge to explore and interact with our world through play is one of humanity’s most important and universal characteristics. All societies play. All people play.

When confronted with a baby in crib, almost all of us will instinctively launch into playing a game designed to teach the principle of object permanence: “peek a boo”. This instinctive behavior is what has allowed us to solve some of the most challenging facing us. Think of the simple games of hide and seek, or the 100 meter dash; two games with clear roots in survival. Our earliest ancestors played these games, in order to build and improve critical survival skills. We owe a debt to these games for the very survival of our species.
Dopamine is the neurotransmitter most strongly associated with learning, goal directed behavior and motor behavior. It is distributed through dopaminergic pathways in the brain that extend from the midbrain to the neighbouring motivational and motor parts of the brain. When scientists block dopamine’s release in mice, rewards cease to be effective. For example, food becomes unmotivating, sex and even consuming cocaine stop being self-reinforcing behaviors. Without dopamine we appear to stop wanting because we stop anticipating the pleasure of a reward.

Dr. Robert Sapolsky at Stanford University has shown experimentally that in repeated behaviors the anticipation of pleasure will begin to trigger the dopamine before the reward arrives. The anticipation of a reward can be intensely pleasurable, while completing a behavior may be less so. For example, anticipating a great meal can be a more dopamine-rich experience than eating the meal itself.

In the game play context, improving one’s performance from try to try, or receiving an anticipated (or unanticipated!) game play bonus can trigger the release of dopamine, rewarding the player for participation and encouraging continued engagement.
Oxytocin

Oxytocin is a neuropeptide, manufactured in the posterior pituitary gland in both men and women. Women have more oxytocin receptors, so we often associate this hormone more with women than men, but in both sexes it plays an important role in facilitating cooperation, generosity, and other pro-social behaviors.

Its presence is associated with feelings of trust, honour, and affection\(^3\). Although recent study shows this is context related\(^4\): in some people, oxytocin also strengthens memories of bullying and negative social experiences increasing their fear and anxiety in certain contexts\(^5\). Oxytocin can not only facilitate bonding, but it can also increase skepticism about “outsiders”. Perhaps the Cuddle Hormone needs a new nickname. We suggest the “Us versus Them Hormone”.

In the digital world, oxytocin is closely associated with social features in applications and games. There are several game-based features that can trigger oxytocin: checking facebook, seeing positive incoming messages from friends and family, and receiving gifts of virtual goods. Facebook has been shown experimentally to result in releases of oxytocin by Dr. Paul Zak. With its half life of 30 minutes and easy, social triggers, oxytocin is a steady presence in most people’s digital lives.

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Serotonin

Serotonin also known as 5-hydroxytryptamine, affects reward assessment in decision making. A neurotransmitter created from the tryptophan we ingest in our foods, serotonin also influences and helps regulate our mood, sleep, body temperature, sexual desire and function, and social perception. As many of our receptor sites are in the gut, serotonin is closely related to appetite and satiety. In some people it appears that serotonin is not well-received in the brain, resulting in depression—either due to a lack of tryptophan, lack of serotonin, or a resistance to serotonin. There is no way to measure serotonin in the brain, only the blood. But selective serotonin reuptake inhibitors (SSRI) do alleviate the symptoms of depression in some people. Increasing exercise has the same benefit.

In games and digital applications with risk and reward, Serotonin helps us gauge the value of an outcome in a game, using costs & benefits (risks and rewards) when making a decision.

Adrenaline

Emotional responses in some games can include suspense and fear, which trigger the release of epinephrine, an adrenaline response. For most people stress and fear lead to avoidant behaviors, but some games include elements that intentionally arouse fear and stress as a way of heightening adrenaline—which can increase focus, alertness, and increase heart rate. Adrenaline has follow-on sensations of relief as endorphins are released. In game psychology this extreme tension and release is an element of what is called Fiero. The release of epinephrine also increases the consolidation of memory, particularly as we learn to recognize threats; it is also associated with trauma effects.

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One of the top 10 most downloaded exercise applications (Zombies, Run!) uses scary sound effects, a Zombie narrative, and time boxed challenges to heighten epinephrine concentration in the blood, which in turn boosts the runner’s energy. In digital applications, introducing a countdown to a challenge (also called time boxing an activity) can increase the release of epinephrine, particularly as the time runs out. For calming applications, timed/countdown mechanics should be avoided.

**Endorphins**

Endorphin is a contraction of “Endogenous Morphine”. Endorphins are naturally-occurring opioids that provide a euphoric release from stress and pain, and can be triggered by winning, catharsis, exercise, meditation, some foods, UV light, and laughter. Endorphins are produced throughout our day through our expression of gratitude, appreciation for the beauty of our surroundings, social interactions and challenges. They are also released by the belief that a treatment is working and may underpin the Placebo Effect in pain relief.

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How do we practice Playful Design?

According to Ernest Adams in *Fundamentals of Game Design*, a game is an activity “in which the participant(s) try to achieve at least one arbitrary, non-trivial goal by acting in accordance with the rules.” There are a few things I’d like you to notice about this definition. First, notice the lack of the word “fun” in that sentence. In fact, a quick Google search for the “definition of game” shows a noticeable absence of the word. That’s because “having fun” is only one possible mental state a game can put you in. Games can be, and many are, delightful and surprising—from “Jack in the box” to charades, but there are other important states of mind that games can put you in, and these can be just as useful to us.

Flow, for example, is a state of mind one can get into while playing a game that is calm and focused. While fun is about excitement, about peaks and valleys, flow is about a steady state. In many ways, flow and fun pull against each other; each can be useful in different contexts to promote engagement.

It’s important to note that each of these states of mind, and any others we care to think of, are not properties of the game, but effects of the game. It is not the game that is fun, it is the player who is experiencing fun through playing the game.

Nicole Lazarro is an interaction designer that draws upon her research into the psychology of emotion. She categorized game-based experiences into four “keys”. Each good game has a different mix and at least two keys of fun. She uses the term “fun” as a catch all for the many engaging, states of mind a player may be in. Her four keys are: “Hard Fun” (a frustration-
accomplishment-relief experience that can be very absorbing); “Easy Fun” (a curiosity-driven, playful experience that can be very imaginative); “Serious Fun” (a meaningful, practice-based experience that can be relaxing) and “People Fun” (relationships-based experience that can be amusing, mentorin and expressive).

Let’s take a closer look at how behavior change and patient engagement connect to these keys of fun:

<table>
<thead>
<tr>
<th>People Fun</th>
<th>Serious Fun</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. Facebook, Twitter, social games</td>
<td>e.g. Wikipedia, Brain Age</td>
</tr>
<tr>
<td>Actions: cooperate, compete, mentor, lead</td>
<td>Actions: research, practice, relax, excite, demonstrate expertise</td>
</tr>
<tr>
<td>Focus: relationships</td>
<td>Focus: beliefs about the world</td>
</tr>
<tr>
<td>Game elements: challenge, message, gift, encourage/like, ranking/leaderboards, simulated caretaking (tamagochi),</td>
<td>Game elements: agency, discoverable rules, simulation, repetition, collections &amp; completeness, alternative path (Choose Your Own Adventure), narrative</td>
</tr>
<tr>
<td>Patient needs: social support, encouragement, mentoring, “find one’s tribe”, recognize “change is possible in people like me”, ongoing engagement</td>
<td>Patient needs: self-efficacy &amp; education, context &amp; ability to see real-world examples, practice and take safe risks, move beyond fear, precontemplation to action, look back on success</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hard Fun</th>
<th>Easy Fun</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. Flight simulator, Diner Dash</td>
<td>e.g. Pinterest, Survival Craft</td>
</tr>
<tr>
<td>Actions: reach goal/win state, master fear/stress/obstacles, strategize, problem solve</td>
<td>Actions: explore, creatively express, curate, imagine</td>
</tr>
<tr>
<td>Focus: concentration, strategy</td>
<td>Focus: relaxation and curiosity</td>
</tr>
<tr>
<td>Game elements: countdown, goals &amp; obstacles, levels, “boss monsters” (hard foes)</td>
<td>Game elements: control and free navigation, unlock mystery, experience awe, create a beautiful imagery</td>
</tr>
<tr>
<td>Patient needs: short term educational experience (single play experience), and emotional intensity.</td>
<td>Patient needs: positive stress-free experience, agency, consider viewpoints and imagine alternative outcomes.</td>
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</table>
In the playful and well-researched book *Game On: Energize your Business with Social Media and Games*, Jon Radoff lists out “42 fun things” that cover the entire emotional spectrum. Each one contains varying combinations of curiosity, anticipation, resolution, power, idealism, social & physical space, order and awe.
The reality is that points, in and of themselves, are not very engaging. That’s not to say they’re irrelevant: they can help you keep track and provide a convenient shorthand for progression and mastery; but an incrementing number alone exerts minimal influence on the motivation to move forward.

Think of a game as an economy, with inputs (effort, time, information), industry (the mechanics of playing), and outputs (emotional satisfaction, physical prowess, social status). Points are like the currency of that economy. They’re only meaningful to the participant insofar as they represent value created in your game’s economy. If they don’t represent some value to the participant, then they’re, well, pointless.

Gamification, or as we prefer to say—Playful Design, therefore, is not about layering points and badges on top of your program to reward participation. It is about using the behavioral psychology of play to help the participant make a psychological/emotional commitment to the program itself. After all, bribery is a poor sort of game.

So how is that done? Ayogo CEO, Michael Fergusson identified the key elements that must be integrated for a system to be properly called “gamified”. They are: Agency, Challenge, Uncertainty, Discoverable Rules, and Outcomes.
Agency: There must be real, meaningful choices the participant can make at every important junction.

Challenge: A real conflict or difficulty must be engaged or overcome; for longer-term engagement, the challenge should become progressively more difficult. In good games, that progression alternates between easier experiences where you feel comfortably within your zone of control and difficult experiences where you must draw upon all the skills you've learned and your chance of success on the first try is very low. These high-challenge experiences are called “Boss Fights” in games, and they are used sparingly, typically as the player strives to complete a level, allowing the player to “level up”.

Uncertainty: If the path to accomplishing a goal is unambiguous the design is good, but it is not a game. If a player is 100% sure that their action will result in failure, they will not attempt it. Ambiguity and risk are both elements of
uncertainty. Finding an optimal balance of clarity and mystery, risk and reward is an important part of engagement design. Both mystery and risk are engaging because they trigger anticipation and anticipation signals the release of the neurotransmitter dopamine. Dr. Sapolsky says “‘maybe’ is addictive like nothing else”, meaning dopamine rises if the possibility of reward is less than 50% certain.

Discoverable Rules, or constraints: Not just in the sense of following rulebook—feedback must help you partially discover what works. Scaffolding, hints, and onboarding tutorials help the player understand how to progress. But true engagement comes when the player uncovers a strategy for themselves that takes them deeper into the experience. For example, in the game Candy Crush Saga, the blinking candies give new players a hint by suggesting a move. But as players become more experienced, they learn to disregard these basic hints, in an effort to discover more advanced strategies that will be necessary to reach the more difficult levels of the game. In the words of hockey great Wayne Gretzky, they must learn not to skate to the puck, but rather, skate to where the puck is going.

Outcomes: There must be meaningful, recognizable outcomes. This doesn’t have to just be win/lose/draw at the end. Within the game itself, each digital experience should have a recognizable outcome designed for that particular patient. For example, in one of Ayogo’s health games, players who complete a level unlock a new chapter in a Choose Your Own Adventure game that provides meaningful advice on the skills and situations they need to master as they deal with a chronic health challenge. In another Ayogo application, players who are dealing with
insomnia unlock soothing audio tracks they can use to wind down and fall asleep, while simultaneously reinforcing users’ decision to shut off the visual noise/blue-light from their screens that can interfere with sleep.

Of course, it’s a challenging project to apply these principles in a scientific way to healthcare applications. Challenging as it may be though, a growing body of scientific literature and a growing number of successful applications in the field are increasing our understanding of this aspect of human psychology. As these technologies are piloted and evaluated, we gain increasingly concrete evidence that playful design is effective in shaping engagement and changing health behaviors.