Chapter 6
Guidelines for Designing Effective Games as Clinical Interventions:
Mechanics, Dynamics, Aesthetics, and Outcomes (MDAO) Framework

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ABSTRACT

Games are a successful pedagogical tool to change attitudes and behaviors. This chapter will examine how games facilitate change, discuss common pitfalls, and outline best practices for making serious games for clinical practice. Sustained engagement and motivation are key to lasting clinical interventions. When developing a game for clinical practice, the designer should avoid "punishing by rewards" (Kohn, 1993), damaging motivation towards the desired goal. Understanding game design principles is crucial to creating intrinsically engaging experiences that lead to lasting motivation. The Mechanics, Dynamics, and Aesthetics (MDA) framework is widely accepted by game designers as a framework to make compelling games. Using MDA as a base for understanding how to create engaging experiences, this chapter proposes a new framework for serious games called Mechanics, Dynamics, Aesthetics, and Outcomes. MDAO describes how to design a game that is intrinsically motivating and effective by focusing on the interplay between outcomes and other vectors of design.

INTRODUCTION

A clinical intervention can be any program, activity, or experience designed to promote specific health outcomes. Not all interventions are games, but games have been shown to excel at engaging, motivating, and teaching - qualities that are valuable in interventions. To take full advantage of the engaging, motivating, and teaching potential of games, a designer must understand the elements that come together to create a *game*, and their implications for motivation. In this chapter, those interventions that meet the definition of a game are referred to as "serious games" (Abt, 1970), being

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distinct from entertainment games in that they have an explicit intended outcome beyond entertaining the player. Many interventions that are designed with the intention of being games, or harnessing the motivational potential of games, fail to include all of the elements that would make them true serious games. These game-based interventions are unable to benefit from all that games have to offer as a medium for clinical interventions.

Most game-based interventions fall short of being true serious games because of a fundamental misunderstanding of the motivational nature of games. The definition of a game that is provided in this chapter will help to clarify this misunderstanding and illustrate the potential that serious games have as interventions. The most common type of game-based interventions, and perhaps the most worrying, is "gamified" interventions. Gamification is the process of adding game-like extrinsic rewards to an activity without adding the other elements that serve to create an intrinsic motivational framework. This approach has become popular because it appears to be effective early on, but as participants continue, they often begin to feel like they are being punished or controlled. This limits the effectiveness of gamified interventions, and can even leave participants feeling less inclined to work toward the goal of the intervention than they were prior to participating in the intervention (Deci, Koestner & Ryan 2001).

This chapter will present the challenges inherent in the medium for those interested in harnessing the potential benefits of games as clinical interventions, as well as propose a framework on which to base the game design process for clinical interventions. The chapter begins with a look at common design flaws that prevent interventions from fully utilizing the potential of games. An in-depth definition of games is provided and used to explain where and how interventions can fall short of becoming effective serious games, and why games are such an effective format for interventions. Next, the chapter will discuss the existing Mechanics, Dynamics, and Aesthetics (MDA) framework of best practices for game design, and present the new Mechanics, Dynamics, Aesthetics, and Outcomes (MDAO) framework, which adapts those practices to a more specific use in serious games. Finally, the chapter will cover the process of putting MDAO into practice, including a step-by-step example of making a hypothetical serious game, in order to familiarize designers with this process and help them create more effective serious games.

BACKGROUND

Beyond Gamification

In order to create effective serious games, it is important to understand why and how games create engaging motivational experiences that can lead to behavior change. The primary reason for this is that games are able to create intrinsic motivation, rather than relying on coercive extrinsic motivations. Deci and Ryan (2000) define intrinsic motivation as engaging with an activity because it is inherently interesting or enjoyable, and extrinsic motivation as engaging with an activity because it leads to a separable outcome. There are many misconceptions about what makes a game intrinsically motivating.

According to Gurau (2008), some of the misconceptions that have led to the creation of so many game-based interventions, when true serious games would have been more effective, come from a study by Chen and Ringel (2001) on "advergames" – game-based experiences designed to advertise products. In this study, the authors recommended that games should be kept simple in order to promote continuous interaction, a profound misunderstanding of the nature of engagement in games.

Today, we see many non-game activities with game-like elements poorly thrust upon them in misguided attempts to make tedious activities more engaging. The most common game-like elements

that are added in this manner are achievements, points, and leaderboards, which are used as reward systems. This has become a widely used core mechanic for many applications aimed at behavior change, such as "Calorie Counter" and "Nike +". This method of creating game-based interventions by adding reward systems is what this chapter refers to as "gamification". In gamified experiences, elements that serve a beneficial purpose as feedback mechanisms in games are added to experiences to function as extrinsic reward systems. There is a limit to the efficacy of gamification, and research has shown that it has detrimental effects on long-term behavior change, primarily that adding game elements to an experience as a form of extrinsic motivation does not create the same positive intrinsic motivational effects as a well-designed game (Deterding 2010). Gamification also runs afoul of the phenomenon of "punishing by rewards", wherein rewards successfully create short-term motivation, but in the long term, they end up being perceived as a form of control, and eventually even as a threat (Kohn, 1993). When this happens, rewards have the same psychological effects as punishments, and can damage or destroy any intrinsic engagement that the participant had been experiencing before the rewards were added (Kohn, 1993). When designing interventions, it is important to leverage the motivational elements of intrinsic engagement, while avoiding the damaging effects of extrinsic motivation.

When game-like features are added to a non-game experience, it represents a misunderstanding of the essential characteristics of a satisfying game. Games are able to create intrinsic motivation because they put players into a playful mindset. The following sections will show how adding game features to non-game interventions is insufficient to create this experience, and how extrinsic reward structures interfere with the mechanisms that lead to a playful mindset. In order to take advantage of the intrinsically engaging nature of games, and avoid punishing participants with extrinsic reward structures, designers must go beyond gamification, and turn game-based interventions into true serious games. In order to understand how serious games can be more effective than game-based interventions, the next section will examine what it is that makes games engaging and motivating.

Engagement and Motivation in Games

Many authors have written about how to create immersive and engaging games (Hunicke et al., 2004; Koster, 2005; Rigby & Ryan 2011; Rogers, 2010; Salen & Zimmerman 2003; Salen & Zimmerman, 2005; Schell, 2008). Interventions hoping to leverage games' ability to motivate, engage, and teach must understand the elements of a game and how they come together to create these effects. In a broad sense, games do this by putting participants into a "play" state of mind through creating a lusory attitude (Salen & Zimmerman 2003). This is the state of mind that players are in when they are enjoying the activity presented for the pleasure of play itself. This lusory attitude is a very positive and enjoyable state for players to be in, and is at the core of the intrinsic engagement of games. In other words, a game creates intrinsic engagement by providing its players with a setting that fosters a lusory mindset. All of the elements that define a game, which will be discussed in the following section, contribute to the conditions that foster a lusory attitude. Because of this, all game-based interventions, even ones that avoid damaging reward structures, will fall short of the potential that true serious games have for creating intrinsic engagement.

Reward systems are often used in game-based interventions, and many rewards can serve to detract from the intrinsic motivation of an experience by creating an extrinsic framework of value. To avoid interfering with intrinsic motivations, rewards in serious games should be noncompeti-

tive, reinforcing, and contingent upon performance standards rather than task engagement. The performance standards used in the rewards process should be kept objective and attainable, in order to avoid discouragement (Dickinson, 1989). In other words, rewards should be used as mechanisms to provide players with feedback on their performance. This way, their desirability encourages continued play, as players seek to improve the quality of their gaming experience. In addition to rewards, other controlling structures serve as extrinsic frameworks: threats, deadlines, directives, and competition for rewards (Deci et al., 2001). It is more likely that the desired outcome of an intervention will be achieved if the intervention is built as an intrinsically motivating experience, rather than relying on these extrinsic frameworks to drive motivation.

A main distinction between intrinsic and extrinsic motivation is the perceived degree of control of the participant. If the player does not feel that their participation in a behavior is free and voluntary, but rather coerced by a desired reward, they will ultimately be less likely to engage in that behavior. If a participant is engaging in a behavior that they do not enjoy, in order to receive a tangible reward, then the reward is acting as a damaging external reward framework (Deci et al., 2001). It is important to avoid creating controlling extrinsic motivational frameworks, not only because they are ineffective, but also because they damage intrinsic motivation, especially after the reward structure is removed (Deci et al., 2001). By understanding the mechanisms with which games create intrinsically motivating experiences, serious game designers can develop interventions that are more likely to be lasting and effective. To facilitate this, a formal definition of a game is provided below, followed by a discussion of each of the elements that make up a game and how they help create intrinsic motivation.

What Is a Game?

In order to make effective serious games, and avoid making game-based interventions that lack the potential of serious games, it is essential that serious game designers understand what a game is. A frequently quoted simple definition of what constitutes a game is: "the voluntary attempt to overcome unnecessary obstacles" (Suits, 1987). To exemplify many of the attributes of a game, consider the game of basketball. In basketball, the goal of the player is to put a ball through a hoop. If this goal was the only part of the rule set, the player could simply walk to a hoop and put a ball through it. The game provides obstacles to this goal that would be unnecessary for the player to go through to achieve this as an unrestricted goal. The rule set puts the hoop high in the air, and puts 5 other players in the way of accomplishing the goal. Suits' concise definition of a game is particularly useful because it explicitly mentions the notion of voluntary participation, which is a factor that is often overlooked in game-based interventions. Suits' definition outlines the bare essentials to creating a lusory attitude (Salen & Zimmerman, 2003). For a more in-depth understanding of what makes a game, designers can look to the definition proposed by Caillois (1961), which is a comprehensive list of attributes that create the type of engaging experience that people call a game. Caillois's definition requires a game to be free, separate, uncertain, unproductive, governed by rules, and make-believe. In order to facilitate the most thorough understanding possible, this chapter proposes and utilizes a modified version of Caillois' definition. A game is:

- **Free:** Participation in a game is voluntary, and without obligation or coercion. For the purposes of this chapter, this is interpreted as referring specifically to the mindset of the player as they are playing. As long as

the player's attention is focused away from extrinsic motivations during play, they are experiencing the freedom that defines a game.

- **Separate:** A game is distinguishable from real life. A game exists in a firmly defined, circumscribed time and space.
- **Uncertain:** A game allows for player choice in the specific course of events, the results of which are unforeseeable.
- **Unproductive:** In-game labor is unnecessary to the completion of the player's goals. In Caillois' definition, being unproductive means that the player's actions can have no productive effect on the real world. The interpretation used here takes a phenomenological perspective and argues that importance lies in the perception of the player, rather than the game's effect on the world. As long as the labor is unnecessary in the eyes of the player, it meets the requirement of being unproductive.
- **Governed by Rules:** Rules create a new framework for acting in the world, set up unnecessary obstacles, and provide conventions that create the novel world that the player exists within.
- **Make-Believe:** Distinct from real life. The awareness that the goals and rules are separate, arbitrary, and unnecessary, creating a novel contained reality for the player to step into.

The proposed definition of a game accounts for the player's subjective experience more than Caillois' original definition did. This is supported by research showing that a player can become engaged with the enjoyment of an activity, and experience it as an overall intrinsically engaging experience, even if the player's initial participation is driven by a desired extrinsic reward (Deci & Ryan, 2000; Deci et al., 2001).

The reason that game-based interventions fail to achieve the level of intrinsic engagement that is possible in serious games is that they fail to include all of the elements that games use to promote a lusory mindset. The definition of a game provided here can be used as a handy checklist for designers to see if their intervention meets the definition of a game. This is a technique promoted by Professor Greg Niemeyer in his University of California Berkeley game design classes (personal communication, April 18, 2012). Game-based interventions frequently fail to meet the criteria of freedom, separation, unproductivity, and make-believe. These elements are closely tied, and are crucial for creating a lusory attitude, and thus inspiring motivation, engagement, and self-efficacy (further discussed in the section on behavior change.)

Encouraging a mindset of freedom is crucial to games, because any element that draws the player's attention away from the playing of the game can cause them to lose their lusory attitude and damage their intrinsic engagement. To be truly "free", or voluntary, a player must engage with the experience regardless of outcome. This can be particularly challenging for serious games to achieve, because they are designed explicitly for players to achieve extrinsic objectives. For some interventions, a player's participation is involuntary, for others it is influenced by the desire to achieve the stated objective. The important part of this attribute, however, is specifically the player's mindset during play. In other words, the issue is one of attention, rather than intention. If the player's intention in playing the game is to become a better runner, this does not necessarily preclude a lusory attitude. But if their attention while playing is on that outcome, rather than on their in-game goals, the experience has failed to become a game for them. Even if a player's initial reason for choosing this activity is based on a desired outcome, the player's motivations for the actions that they

take in the game must be in-game motivations. The subjective nature of this attribute means that some activities may be a game for one person, but not for another. A professional basketball player who is focused on making sure they get another million dollar paycheck is not able to achieve the same lusory attitude as a child whose attention is focused solely on the game.

Separation helps players maintain a lusory attitude by creating a space where they are safe from outside concerns. By occurring in a discrete, circumscribed time and place, games promise to take players away from their external concerns for a time, while also promising to return them after the experience is over. A game like basketball happens in a specific location over a specific amount of time, and is thus circumscribed and separate from real life. Separation is one of the hardest pieces to get right in a game-based intervention. By definition, a serious game is trying to impact real life and thus is not separate. It is difficult to create a feeling of separation when actions are seemingly productive, impact the real world, and are about real issues, not make-believe ones. Narrative goes a long way to supporting a feeling of separation for players. In the game World Without Oil (WWO), designer Ken Eklund (2011) created a feeling of separation by using an extremely clever narrative device. By setting the game slightly in the future, he circumscribed the reality his players were playing in. In WWO, players played as themselves, but told stories from their future lives. The simple act of imagining themselves as living in the future created the needed separation for the players. The game was no longer about their lives, but about some future self, in a future time, that they were free to explore. With these ideas thus circumscribed from their real life, players were able to come up with unique and innovative solutions to problems surrounding peak oil. In real life, these problems are daunting, and failing to come up with effective solutions has disastrous real world consequences. In an experience that is "separate", the fear that goes along with real life failure is mitigated, thus empowering the participant to be more inventive and experimental.

An activity is uncertain when the participant cannot easily predict the outcome. When there is only one solution to get around an obstacle, or when a problem's solution is too easy for the player, the outcome becomes certain. Certainty takes away any feeling of challenge in the activity, and is essentially the same thing as not having obstacles. If basketball was played in a static course, where all of the opposing players did the exact same thing every time, there would be certainty because there would be one optimal solution to getting the ball through the hoop. If this was the case, basketball would become a puzzle rather than a game. Additionally, uncertainty means that there is some capacity for the player's own actions to impact the outcome of a game, granting the player an empowering sense of agency and control.

According to Caillois (1961), being an unproductive activity means that the actions in the game only affect the game itself, and not anything in the real world. The requirement for a game to be an unproductive activity is seemingly incompatible with the idea of a serious game. However, games are about creating the subjective experience of a mindset of play, so as long as the game activities are unnecessary in the eyes of the player, the designer can create the illusion of unproductivity. This happens on two levels. First, the player's attention during the game must be on in-game goals that are not a direct reflection of the game's outcomes. For example, in basketball, the goal of putting a ball through a hoop does not affect anything in the real world. Therefore, the in-game goal is successfully unproductive. Second, the game should include obstacles that are unnecessary to the completion of the in-game goal, similar to the obstacles mentioned in Suits' definition of a game (1987). In basketball, the other players, the height of the baskets, and all of the other rules represent these obstacles. These obstacles present the player

with clear objectives for all of their actions, which are further removed from the productive outcome of a game. Distancing actions from outcomes is important, because it is the actions that the player takes during the game that ultimately lead to the desired outcomes. Therefore, if their actions are not viewed as sufficiently unproductive, the player's attention may be recalled to the real world outcome of the game.

When an activity is governed by rules, it is creating an alternate set of laws for the player. The rules set out the parameters of the game. The obstacles and goals of a game are all created in the rule set. Rules help to create a feeling of separation and make-believe by creating the novel space in which the game takes place, and by outlining what is expected and allowed in this new space. The rules of basketball define how long play goes on for, what the goal is, and the acceptable means that are available to accomplish the goal.

Finally, a game needs to create a make-believe world for players to step into that allows them to let go of attachment to the real world outcomes offered by the game. In the real world, the results of people's efforts are tied into their egos. Whether they fail or succeed is important to them, because it means something about their status and competence. People fear failure in real life, because failing reflects directly on them as a person. When the real world consequences of failure are taken away, that fear is taken with it. If people feel free to experiment without negative consequences, they are more willing to stretch themselves and try things that may not succeed. If the player's main focus while playing a game is on the beneficial outcome of the game, then the experience has failed to be a game for them. In this case, the player is using an extrinsic framework to view their participation, and is not experiencing the activity with the lusory attitude that allows them to have an intrinsically engaging experience. Even in games with a real life outcome, the player's focus must be on their in-game goals. The potential to break the make-believe aspect of a game exists in both serious and entertainment games. When winning becomes a motivation unto itself, when position on a leaderboard or financial gain is the motivating factor, for example, the walls of make-believe break down and playing becomes a grind, rather than an intrinsically rewarding experience. In games like basketball, this make-believe is created by things such as building team identity, so that the players are now acting on behalf of their team against other teams, all of which are constructs that only exist within the game.

This definition of a game serves both as a tool for analyzing and learning from existing serious games and game-based interventions, and as a guide for making new serious games. Experienced designers can use this definition as a checklist while designing serious games, and thus leverage the engagement and motivational power of games. One of the most important elements for serious game designers to focus on is building a strong and interesting narrative, creating a separate, make-believe world for players to exist in. Most importantly, a serious game needs to distract players from its real world outcomes during play, rather than highlighting them. This can be done effectively by designing in-game goals that cause, but are distinct from, the real world outcomes of play. Once an experience meets the definition of a game, it contains everything it needs to draw players into a lusory state. However, it is possible to increase player engagement beyond the basic lusory state common to all games, and serious games can benefit greatly from this practice.

Flow

Flow is an element that can be extremely beneficial to engagement, and can increase engagement beyond that created by the pleasure of a basic lusory state. When a person is fully engaged in the challenge of a game, they are utterly focused and directed. They enter a state of deep concentration, accompanied by a feeling of control, a loss of self-consciousness, and an altered sense

of time (Csikszentmihalyi, 1997). This state of intense focus and concentration is referred to as "flow", and the ability to bring the player into a state of flow is one of the most powerful tools that games have to create an engaging experience. The experience of a flow state is highly pleasurable, and as such is a very potent source of intrinsic motivation.

To create a sense of flow, an experience needs to give its participants a clear goal to focus on, immediate feedback on their actions, and tasks that challenge the participants to an appropriate degree (Gregory, 2008). Games, by their nature, are an ideal medium for engaging people in a state of flow. All games provide their players with clear goals. They set out explicit conditions to win or progress, and obvious obstacles to those actions, from which the player can always identify their current objective. Games also provide feedback. The clear goals provided by the game allow players to know clearly whether or not they succeeded. If a basketball player misses a shot, that gives them feedback about their aim. More complex systems of feedback are possible, especially in video games, where every decision a player makes can trigger visual, audio, and even physical feedback. Systems of points and awards can also serve as feedback mechanisms and, when used in this way, don't have the same negative effects as when they serve only as extrinsic motivators. Finally, games can be designed to different difficulty levels, which can be tailored to specific audiences. The most important element in creating flow, however, is the matching of the difficulty of the activity to the skill level of the participant. Flow can only occur when the participant is challenged, but not to the limits of their skill. If a task is too far below a participant's skill level, they will feel bored and anxious. If the task is at or beyond the limits of a participant's skill, they will feel frustrated and stressed. Even if the player is able to complete a task at the limits of their skill, it may take too much effort and leave them too frustrated or exhausted to experience flow. A flow-enabling task must be challenging without being frustrating (Gregory, 2008). Video games excel in this area because they can offer the player a choice of difficulty levels to play at, and because they are able to change difficulty instantly in response to a player's performance. It is possible to create a state of flow by having adaptive challenges that stay on the edge of a player's ability. Games like Tetris that become increasingly difficult and allow the player to continue playing until they fail are effective at creating flow states (McGonigal, 2011).

Being pleasurable, the state of flow provides an avenue for creating intrinsic motivation (Csikszentmihalyi, 1997) and thus aids the adoption of a lusory state. When the challenges being presented are appropriate for the participant's skill level, they gain a feeling of mastery of their skills and control over the outcome of events, leading to increased confidence and self-efficacy. The intense focus and concentration that are the hallmarks of the flow state also induce the participant to block out distracting stimuli, such as preoccupations and feelings of self-consciousness. This combination of increased confidence and self-efficacy with decreased negative emotions leads participants to take more risks and experiment with new ways of using their skills, creating more opportunities for learning and increasing the rate at which they learn and build competence (Csikszentmihalyi, 1997; Deci et al., 2001). The self-efficacy that is experienced during the flow state also increases the likelihood of long-term behavior change (Ajzen, 1985; Schwarzer, 1992; Rosenstock, 1974).

How Games Encourage Behavior Change

For most clinical interventions, the ultimate intended outcome is long-term behavior change. Thus, it is valuable for all serious game designers to understand mechanisms for behavior change. Effecting change in a person's behavior, even in a willing participant in a clinical intervention, is more complicated than simply providing infor-

mation. The theory of planned behavior (Ajzen, 1985; Ajzen, 1991) is a useful way to explain the elements needed to support and motivate behavior change. Interventions that intelligently target all of these elements will be the most effective.

The theory of planned behavior lays out three predominant factors that encourage the adoption of a specific behavior: attitude, subjective norm, and perceived behavioral control. Attitude is based on the person's own perception of the behavior. Subjective norm is the person's conception of the communal or societal perception of the behavior. Perceived behavioral control is the degree of self-efficacy that the person has in respect to performing the behavior. Many theories of behavioral change include self-efficacy as a key factor in creating lasting change (Ajzen, 1985; Schwarzer, 1992; Rosenstock, 1974). The combination of a person's own view that a behavior is positive, their view that the wider opinion of that behavior is positive, and a positive perception of their own ability to control the behavior leads to a strong intention to perform the behavior (Ajzen, 1991). Intention is highly predictive of actual execution of a behavior, as long as the perception of behavior control is not unrealistically high (Ajzen, 1985; Ajzen 1991). Therefore, increasing the strength of the intention is likely to increase adoption of the behavior.

Many serious games have focused on raising awareness of their target issue to create behavior change. Focusing solely on raising awareness is a failure to harness the true power of games to change behavior. Awareness is a part of behavior change, but is by no means a complete solution. Even in cases where subjects have a positive attitude about the effects of a behavior and perceive a positive subjective norm, they can still be resistant to behavior change if they lack self-efficacy (Ajzen, 1985; Ajzen, 1991). For example, a person who knows the beneficial effects of exercise and whose peers are very positive about exercising might repeatedly fail to follow through with an exercise plan if they believe that exercise is difficult or that they cannot fit it into their schedule. Subjects must feel capable of a behavior in order to adopt it. This is why building self-efficacy is a crucial element to consider when designing clinical interventions – raising awareness will only affect attitudes and subjective norms, which are not sufficient for behavior change (Ajzen, 1985; Ajzen, 1991).

Implications of Messaging Psychology for Behavior Change

A large body of literature has shown that information can have a deleterious impact on behavior, if it is not presented in a well-considered manner (Hansen, Winzeler & Topolinski, 2010; Jessop, Alberty, Rutter, & Garrod, 2008; Ferraro, Shiv & Bettman, 2005). The way information is "messaged", or framed, has relevance to the recipient's ability to turn that information into practice. The science behind persuasive messaging is often studied, both by advertisers and by health advocates, in order to influence consumer behavior. Creating a positive view of a behavior is not as simple as merely giving players all the necessary information about the behavior. For example, many studies have shown that exposing subjects to images foods increases people's desire to those foods (Cornell, Rodin, & Weingarten, 1989; Ferraro, Shiv, & Bettman, 2005; Marcelino, Adam, Couronne, Köster, & Sieffermann, 2001). As a hypothetical example, a game that informs players about healthy food choices by having them sort healthy and unhealthy food may actually have a negative real world effect on sugar consumption. When creating an intervention, it is important not to conflate awareness or information with behavioral change. In the case of creating a game that involves sorting healthy food from unhealthy food, the designer may have increased the player's knowledge of the nutritional value of food, but they would likely have failed to intervene and help the player make healthier choices. In the best case, the designer has increased the player's knowledge on

the subject without influencing behavior, and in the worst they have increased the player's desire for unhealthy food.

Another tactic that is often misapplied to interventions is fear-related messaging. Not only is the perception of behavior just one aspect of behavior change in the theory of planned behavior, but messages about the extreme negative consequences of a behavior can actually reduce the likelihood that people will stop the harmful behavior. There is an extensive literature showing that esteem-promoting behaviors increase when subjects are presented with mortality (Hansen et al., 2010; Jessop et al., 2008; Ferraro et al., 2005). In addition, when confronted with mortality-related messaging, participants tended to display indulgent behaviors when this indulgence was not detrimental to their self-esteem (Ferraro et al., 2005). It is therefore reasonable to assume that, when confronted with dire health warnings, subjects will employ esteem-promoting behaviors, which may not always be the desired behavioral outcome. For example, a game that shows the player the horrible effects that smoking has on their health may actually increase the likelihood that they continue smoking, as a way of improving self-esteem. Outside of games, this effect is supported by studies that have shown that mortality-related warnings on cigarette packaging can promote smoking in people who use this behavior to reinforce their self-esteem (Hansen et al., 2010). Informing people of the disastrous effects of their actions is not extremely effective and may even be counterproductive. If body image is not essential to the self-esteem of the subjects, they may be inclined to become more indulgent and consume more food when reminded of their mortality. It is important to tread carefully when trying to give a message that changes behavior. Far from being transformative, a dire message reminding people of their own mortality leads people to more firmly identify with, and act in accordance with, their current world view (Arndt, Greenberg & Cook, 2002). If behavior change is the desired result of an intervention, it is important to avoid messages that remind people of their own mortality. Interventions do have occasion to present information that may be uncomfortable to the participants. In these situations, games can create safe places to deal with difficult issues by giving a measure of separation, and creating a lusory attitude. Increasing self-efficacy may also subvert the necessity for self-esteem boosting behavior.

How Games Teach

For interventions whose outcomes require knowledge or skill acquisition, it is important to examine how games teach. Gentile and Gentile (2005) demonstrate that games operate as extremely powerful pedagogical tools for training skills, changing attitudes, and conditioning behavior. They define an effective education as one that:

- Increases the likelihood of skill transfer by demonstrating that there are a multiple ways of solving the same problem.
- Excites and motivates students by providing gratifying stimulation.
- Rewards achievement by presenting difficult challenges that require building on skills previously developed.
- Allows achievement to be recognized by peers.
- Is accessible to everyone regardless of previous experience.

Gentile and Gentile (2005) highlight several aspects of video games that make them such successful pedagogical tools. Games are active and participatory in nature, causing players to take ownership over their actions. This sense of ownership and agency leads to the player feeling a greater sense of connection to their results. Many of the flow-promoting elements of games discussed above also make them successful pedagogical tools. Games provide players with clear objectives that function as unequivocal markers of

success, which increase self-efficacy. Games can have variable difficulty levels that can be adjusted in reaction to the player's performance. This can effectively eliminate boredom and frustration, which are responses to tasks with inappropriate difficulties and can interfere with continued participation. Games also deliver immediate feedback to players as they practice skills, allowing them to continually advance their practice by instantly applying the knowledge they gained from the previous task. Practice usually continues this way until mastery is achieved, greatly increasing the likelihood that players will accurately recall the knowledge gained from their practice in the future. Games can even encourage players to "over-learn", continuing their practice beyond the point of mastery and creating automaticity. The flow state also promotes learning, by increasing self-efficacy and readiness to experiment with new ways of using learned skills.

As Gentile and Gentile (2005) observed, video games create a platform to provide both extrinsic rewards and intrinsic rewards — they award points and trophies, but they also give the player an opportunity to gain validation through accomplishment. Extrinsic rewards in video games provide a mechanism for the player to receive feedback on their performance. This feedback supports intrinsic motivation by helping the player conceptualize their progress. Another key feature of video games for creating intrinsic motivation is the incorporation of levels of increasing difficulty. The skills that a player must master in order to complete one level become foundational skills that are built on in the next. This system of mastering skills, and then building on them in the next iteration, is analogous to the system used in spiral curriculum design to improve learning by creating meaning and purpose. The spiral curriculum model follows the constructivist philosophy of education, and features a progression to more difficult tasks based on mastered skills (Gentile & Gentile, 2005). In this context, mastery of skills is not, in itself, the desired outcome. Rather, it is a step in the process of learning to use the learned skills in meaningful ways. The feedback structures of video games make it easy to conceptualize the value of building skills, and to anticipate their future utility. Additionally, progressing through a system of graduated levels contributes to self-confidence by providing feedback on the player's progress and giving them a sense of achievement.

Games can also take advantage of multiple styles of practice. When a skill is practiced continuously over a short period of time, the player is benefiting from massed practice. Massed practice allows the player to gain competence very quickly, increasing confidence and comfort with the use of the skill. Distributed practice involves using the skill regularly over a longer period of time, with resting periods between practice sessions. This style of practice leads to a more lasting understanding of the skill, and eventually to mastery and automaticity (Hovland, 1938). By combining these two methods of practice, games create a framework to build a more complete understanding (Gentile & Gentile, 2005). Practicing the application of skills and knowledge in a variety of contexts increases the learner's ability to apply them in new, unfamiliar contexts. This happens primarily for two reasons. First, learning across multiple contexts facilitates an abstract understanding of the skill, rather than an understanding of the skill as an algorithm to be applied in one specific set of conditions (Bransford, Brown, & Cocking, 1999). Second, each situation in which a learner is exposed to a piece of information creates a new memory trigger, increasing the opportunities for the learner to recall the information (Gentile & Gentile, 2005).

Another advantage that games have over conventional teaching methods, according to Gentile and Gentile (2005), is that they are "cool". Video games are widely marketed and accepted in society as desirable activities, and skill level can affect social stature. In this way, social recognition within peer groups becomes an additional extrinsic incentive, increasing the desire to continue practicing

and improving skills in video games. A similar dedication to practicing skills in a more traditionally academic way can result in a reduction of social stature (Gentile & Gentile, 2005).

As Gentile and Gentile (2005) point out, the educational process can benefit in several ways from examining the teaching methods found in games. Interventions targeted at information and attitude changes benefit from these methods by focusing on a limited set of core skills or concepts that learners benefit from mastering and overlearning; employing a spiral curriculum, assigning tasks that use and build on the knowledge and skills acquired in previous levels; challenging participants with increasingly difficult tasks; and using intrinsic incentives to motivate participants to meet those new challenges. The mechanisms outlined by Gentile and Gentile (2005) clearly show that video games can have long-lasting effects on players' attitudes and behaviors. From this, it can be inferred that the learning mechanisms present in games have potential for application in teaching and training healthy behaviors.

THE MDAO FRAMEWORK

This chapter draws from a widely used framework that provides entertainment game developers with a basis for building engaging games and a common language to discuss and address the difficulties inherent in creating engaging games. Mechanics, Dynamics, Aesthetics, and Outcomes (MDAO) is proposed as a framework that can serve a similar purpose in building effective serious games. The MDAO framework is modeled after the Mechanics, Dynamics, and Aesthetics (MDA) framework, which encapsulates best practices for entertainment game design (Hunicke et al., 2004). Through the addition of "outcomes", MDAO extends the MDA framework for use by serious game designers.

Components of MDAO

- **Mechanics:** The goals, rule sets, and other components of the game.
- **Dynamics:** The emergent player behaviors that come out of the player's interaction with the game's mechanics.
- **Aesthetics:** The emergent emotional responses that arise out of the player's experience.
- **Outcomes:** Behavioral or intellectual consequences of the player's interaction with the game.

Mechanics are the elements that the game gives players to interact with directly (Hunicke et al., 2004). This includes all of the controls, tools, obstacles, and rules that define, create, and limit the ways in which the game can be played. While it can be useful for designers to talk about games in terms of genres, such as "first-person shooter", it is important to remember that these are made up of sets of mechanics, which can each be manipulated individually. In the example of first-person shooters, the individual mechanics include: "first-person perspective", "player-versus-environment", "skill-building level design", and "realistic physics". Changes to any mechanic can have an impact on the dynamics, aesthetics, and outcomes of a game.

"All players on a team win" - A mechanic in basketball.

The dynamics of a game are the player behaviors that emerge from the constraints created by the mechanics (Hunicke et al., 2004). The mechanics of the game create the system of boundaries that determine the possible ways in which the game can be played. The dynamics are the ways that players play, once presented with those boundaries. For example, if a game includes the mechanics "multiplayer", "ability to communicate with other

players", and "shared win condition", the players of the game might react by creating a dynamic of "cooperation". While all dynamics are ultimately created by the player, the fact that they arise directly from the player's reaction to, and interaction with, the game's mechanics means that a designer can manipulate mechanics to create constraints that intentionally encourage their desired dynamics and discourage undesired ones.

"Cooperation within a team" - A dynamic in basketball that comes from the mechanic "all players on a team win".

Aesthetics are the emotional responses that arise in the player from participating in the dynamics of a game (Hunicke et al., 2004). "Fun" is an inadequate way to describe the emotional engagement of games. Conceiving of "fun" in terms of aesthetics gives game designers a better vocabulary for describing engagement. The MDA framework breaks aesthetics down into eight categories:

- **Sensation:** Game as sense-pleasure
- **Fantasy:** Game as make-believe
- **Narrative:** Game as drama
- **Challenge:** Game as obstacle course
- **Fellowship:** Game as social framework
- **Discovery:** Game as uncharted territory
- **Expression:** Game as self-discovery
- **Submission:** Game as pastime

Basketball creates the *dynamic* of "cooperation within a team". Out of this dynamic of cooperation, players develop feelings of "camaraderie". One of the reasons basketball is an enjoyable game is this feeling of "camaraderie", which is a "fellowship" aesthetic. It is not necessary for aesthetics to focus on positive emotions. For example, fear is a powerful "sensation" aesthetic. Much like a rollercoaster, a horror game may be designed to evoke an enjoyable fear sensation to drive engagement. Both serious and entertainment games have aesthetics, but for entertainment game designers, the primary outcome that they are concerned with is creating specific aesthetics for players to enjoy.

"Camaraderie" - An aesthetic in basketball arising from the dynamic of "cooperation within a team".

The outcome is the real world result of a serious game. Whether intentional or not, all games have outcomes. The outcomes of games designed for entertainment are usually purely aesthetic outcomes. Entertainment games focus on aesthetic outcomes to maximize engagement. Serious games focus on other types of outcomes to produce results that can be useful in a clinical context. Games can have several complementary targeted outcomes designed to strengthen the intervention, but it is essential to be conscious of each of them, and how the mechanics, dynamics, and aesthetics of the game support or detract from each outcome.

"An increased social bond between the players" - An outcome of the dynamic "cooperation within a team" supported by the aesthetic of "camaraderie".

Identifying Desired Outcomes

Concretely identifying the desired outcome is critical to the success of a serious game. Games are a very useful medium, but they cannot be expected to achieve goals that they were not designed to meet. A game that solely teaches *information* about the impact of a high-sugar diet is not likely to change players' eating *behaviors*. It is very important to identify the desired outcome and design the game around creating that outcome.

In order to help serious game designers realize their desired outcomes more clearly, this chapter identifies and presents seven essential outcomes. Nearly every possible intervention should fall into at least one of these categories, and many will fall into more than one.

- **Behavior Change:** Creating a lasting effect on behavior.
  - "*I am now exercising for half an hour a day*."
- **Attitude:** Changing attitude towards particular activities or ideas.
  - "*Exercise is fun*."
- **Information:** Raising awareness, transferring facts, presenting subjective norm.
  - "*Exercising 15 min a day has implications for longevity*."
- **Self-Efficacy:** Supporting perceived behavioral control, building the player's confidence in their own ability to accomplish a specific task.
  - "*I can do it*!"
- **Explicit Skills:** Learning specific methodologies, algorithms, or meta-cognitive skills, gaining a conceptual understanding of a topic, becoming proficient at performing a task.
  - "*I now know proper running technique*."
- **Implicit Skills:** Building executive function, memory, reasoning, problem solving.
  - "*I can now critically reason about my health choices*."
- **Aesthetic:** The emotions the player will feel through playing the game.
  - "*I feel close to the other people I played this game with*."

If *behavior change* is the desired outcome, it is important to understand the mechanisms behind behavior change, and the literature on effective behavior change strategies. Behavior change can be understood using the theory of planned behavior (Ajzen, 1985). The three components of this theory are attitude, subjective norm and perceived behavioral control. These are mapped onto the outcomes of Attitude, Information, and Self-Efficacy, which can come together to support the outcome of Behavior Change, and are discussed in more detail below. When the intended outcome is behavior change, it is important to be clear about what support the target audience most needs in order to enact the behavior change. Determine whether the target audience most lacks a positive attitude, awareness of a positive subjective norm, self-efficacy in relation to the behavior, or some combination of these factors, and incorporate the appropriate factors into the design as secondary or preliminary objectives.

Attitude change can be promoted through both knowledge and emotional experiences. Games with a desired outcome of attitude often include a desired outcome of knowledge as well, but don't necessarily require one. Games are well situated to give players an experience of enjoying something they would otherwise not enjoy by creating an engaging experience around it.

When the outcome of a game is focused on imparting a particular piece of knowledge, it is an *information*-based outcome. In the context of behavior change, the primary role of an information-based outcome is to build knowledge around the subjective norm of a behavior--how others feel about this behavior. This ties into a behavior change outcome through showing participants whether or not the behavior is socially acceptable (Ajzen, 1985). An information-based outcome can also support an attitude change, although it is not strictly necessary for that purpose.

Building *self-efficacy* is one of the greatest strengths of serious games. Games provide separation, are unproductive, and are make-believe. These, and the other essential qualities of games, create a lusory attitude (Salen & Zimmerman, 2003), which allows players to achieve real-world outcomes without a fear of failure. McGonigal (2011) describes this lusory attitude as "an optimistic sense of our own capabilities and an invigorating rush of activity". In other words, it represents a strong feeling of self-efficacy towards a behavior, and the subsequent engagement in that behavior. If the desired outcome of the game is to build self-efficacy towards daily exercise, a game in which the player engages in daily exercise with

a lusory attitude will give the player the experience of self-efficacy toward daily exercise. A game to support behavior change needs to consciously hold self-efficacy as an outcome. To do this, it must be designed so that participants choose to play the game because of its intrinsic enjoyment, not because of their desire for the outcome. To promote self-efficacy, a game must maximize engagement. Building the intrinsic engagement of the game requires understanding the core motivational factors discussed in the background section of this chapter. The game must be intrinsically rewarding by providing opportunities for improvement and achievement. The game must have a clear goal, so that players know what they are working towards. The game must have immediate feedback, so that players can feel satisfaction in their real time performance. And finally, the game must have challenges that match the skill level of the participant in order to create a flow state.

Explicit skill outcomes are defined by the concrete and specific skills or concepts that the designer wants to impart. Many health-related explicit skills center around proper form or technique, such as how to move one's body into particular yoga poses, or how to run without causing injury. A nutritional intervention that highlights explicit skill objectives might train skills such as how to prepare a balanced meal, or how to choose the most nutritious ingredients.

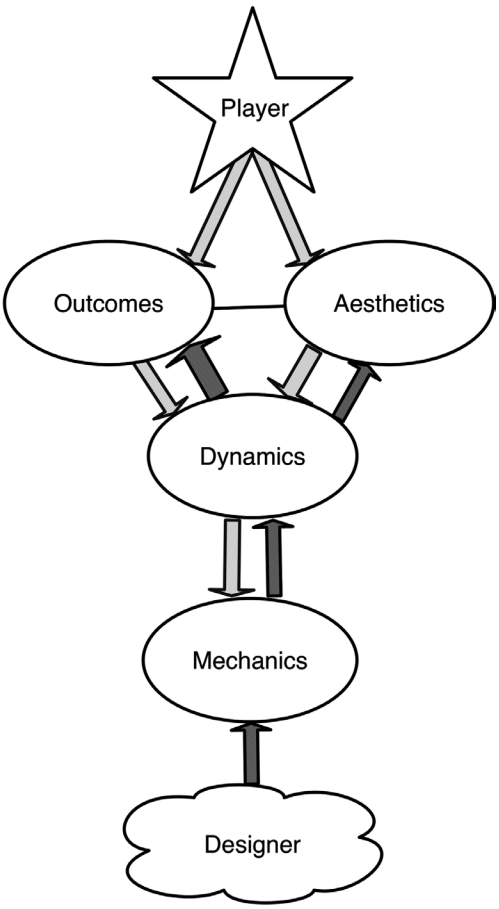
Implicit skill outcomes are focused at building cognitive or physical ability. This can be an important complement to other outcomes, making the intervention more successful than it would be otherwise. For example, individuals with low reasoning ability may not be able to translate the knowledge of which foods are healthy into an understanding of why it is important to make healthy decisions for longevity. Another type of implicit skill outcome is a general fitness increases, such as the ability to run a 5k.

The *aesthetic* outcomes are detailed in the aesthetics section above. Although aesthetics are a type of outcome, their importance, nuance, and ubiquity merit separating them from the other types of game outcomes. It is impossible to have a game that does not have aesthetic outcomes, and these are worth considering separately from other outcomes as a means to produce an engaging game.

Applying MDAO

The designer experiences the game from the opposite perspective of the player, as shown in Figure 1. The designer has the ability to determine mechanics, which inform the dynamics, which in turn influence the aesthetics and outcomes. On the other hand, the player experiences the outcomes and aesthetics, which are created by the dynamics

Figure 1. To use MDAO, the designer must work from the player's perspective



that emerge out of the mechanics. A crucial aspect of the MDA framework is that the designer plans out the game from the player's perspective, starting with aesthetics and then moving to mechanics (Hunicke et al., 2004). The MDAO framework uses the same approach. This way, the serious game designer is focused on their desired outcomes throughout the process, and is encouraged to use only those mechanics, dynamics, and aesthetics that support their chosen outcomes.

The first step of this process is determining the desired *outcome* of the game. It is helpful to narrow down the outcome to make it as specific as possible. An intervention may have a broad mission, but it is important to go through a process to narrow down the goals of the intervention and from those goals identify useful outcomes which support them. Having a specific outcome allows a designer to more easily create mechanics that will lead to this outcome. The process of identifying outcomes involves many stages of research about how to effectively produce desired effects. This research will also help to highlight which outcomes are actually desired, and prevent confusing them for related outcomes, such as confusing *information* with *behavior change*. It is also important to recognize when there is a need for a supporting outcome, as is often the case in serious games with behavior change as a desired outcome. After identifying the critical outcomes, the designer must make sure that the other elements of the game are all aligned with this purpose, and make sure that the outcome is supported by all of the other factors that go into the game.

Although *aesthetics* are a type of outcome, they are an essential element of every game regardless of other outcomes, and thus warrant special consideration. Aesthetics help support other outcomes by making the game enjoyable and increasing engagement. The most important factor when deciding on aesthetics is whether they will align with the other outcomes of the game and contribute to making the game a cohesive experience. All of the eight types of aesthetics can engage players, but some may better support a game's other outcomes, or be easier to implement. While it is possible to have aesthetics that are inappropriate for a specific audience being steered to a specific outcome, they are quite broad and can almost always be effective in some way. For example, an aesthetic of challenge can provide excellent support for an outcome of "exercising on a regular basis". The challenge inherent in basketball motivates players to play repeatedly in order to improve performance. Different audiences may also be more open to certain aesthetics. Younger audiences may prefer games with aesthetics of challenge and exploration, while older audiences may favor aesthetics of expression and community. As with outcomes, most serious games will have more than one aesthetic. In games that build on a narrative, or progress over a longer period of time, there may even be different aesthetics in different parts of the game. Designers must be careful to remain aware of how their aesthetics interact with their outcomes and design for the most symbiotic effect.

The *dynamics* are then planned out, with the goal of supporting and encouraging the aesthetics and outcomes of the game. While the experience of the players is described by the aesthetics and outcomes, the dynamics describe the players' actions. The dynamics of a game do most of the work toward achieving the desired outcomes. Aesthetics are responsible for much of the players' engagement with the game as a whole, but the dynamics are the actions that teach skills and build self-efficacy. Therefore, it is essential that the dynamics of a serious game support the desired outcomes as effectively as possible. Games that seek to build self-efficacy in relation to exercise should feature athletic dynamics such as running and jumping, while games that are meant to improve understanding of healthy diets should include dynamics in which players must consider the health of different choices.

The dynamics of a game also support the game's aesthetics, in order to engage the audience as strongly as possible. If a group of players enjoys social interactions and is motivated by an aesthetic of fellowship, their engagement could be increased by making a game that gives players reasons to create social connections. One way to do this is to design a team-based game. By allowing for dynamics such as "team play" and "competition", basketball gives players cause to relate both to the members of their own team, in a cooperative framework, and also to members of the opposing team, in a competitive one.

There will likely be several dynamics supporting each aesthetic or outcome. For example, a game might support a desired outcome of fitness with dynamics of running, jumping, throwing a ball, and frequent changes in running speed. If the same game supports its outcome with aesthetics of challenge and fellowship, it might add the dynamics of team play, competition, cooperation, passing the ball, and dodging opponents.

Dynamics are more specific than aesthetics, and thus require tailoring to the target audience and the outcomes. Some dynamics may even be detrimental to some outcomes. For example, a dynamic of competition might not support an outcome of "increasing prosocial behavior" and a dynamic of running for an hour would not be suitable for most elderly populations. Serious game designers must choose their game's dynamics to create their desired outcomes while keeping the limitations and tastes of their audiences in mind, because bored and frustrated players will lose their lusory attitude and engagement, and fail to benefit from playing the game. Designers should plan the dynamics that will be most effective in supporting players to achieve the sought-after aesthetics and outcomes.

The *mechanics* of a game are the only part that the designer has complete control over. The dynamics, aesthetics, and outcomes are all determined by the way the player interacts with the mechanics laid out by the designer. Serious game design follows a general pattern of mechanics creating dynamics, which result in aesthetics and outcomes. Because of this, it can be very tempting for designers to start by designing mechanics, and then observe the other elements. MDA proposed taking a reverse approach and outlining a roadmap to the aesthetics before designing the mechanics. This is because the way the player interacts with the mechanics is not always obvious. MDAO proposes the same approach, because a roadmap that tells the designer what outcomes, aesthetics, and dynamics they hope to see can aid them in creating and testing mechanics.

It is good to know what dynamics are being sought because interactions between combinations of mechanics, and between mechanics and dynamics, can be very complex. Small changes in even a single mechanic can create distinctly different dynamics. For example, a visible clock that counts up can support competitive dynamics and encourage continuous practice and replay in order to improve performance. This could be an effective way to support an outcome of regular exercise. A clock that counts down, however, can create time pressure, keep a game from running too long and leaving a player bored and unengaged, or foster a conceptualization of progress as level-by-level or session-by-session, rather than as a continually improving score. This conceptualization of progress by stages would be well suited to supporting an outcome that involves teaching skills by using a spiral curriculum design, which relies on discrete stages with increasing complexity.

Starting the design process with outcomes and working toward mechanics ensures that the mechanics that are used directly support the other aspects of the game. When deciding on mechanics, it is important to keep the audience in mind. This is of special importance for serious games, because they are often targeted at a very specific group. In these cases, the designer must identify their audience's capabilities and interests, and focus on mechanics that are appropriate and appealing. If a game's target audience has extremely limited mobility, it might be appropriate to make a game

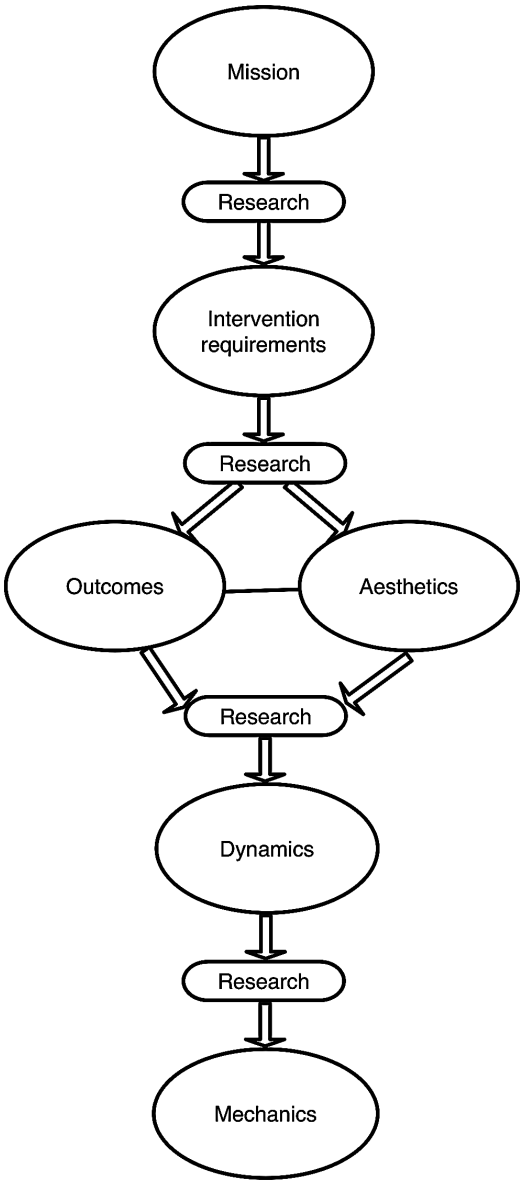
that operates entirely by voice commands. Fully mobile players might find such a mechanic too restrictive, however. Similarly, fast and difficult first-person shooter games are popular with moderately experienced gamers, but may not appeal to the sensibilities or appetites of audiences not already trained in these controls.

Beginning the design process with outcomes and aesthetics also helps with the process of testing and refining mechanics. By having a clear vision of which outcomes and aesthetics they hope to create, designers will have an idea of which dynamics they are hoping to bring out in the players, so that when the mechanics are tested there is a desired result to test them against. As a rule, the best game design comes out of an iterative process of introducing mechanics, playtesting to see what dynamics, aesthetics, and outcomes emerge, and then altering mechanics to more accurately create the desired effects. Playtesting is the process of testing an unfinished game or a specific mechanic by watching it played by people, ideally in the target audience, outside of the design team (Fullerton, Swain, & Hoffman, 2004). This is the process by which designers observe how the MDAO elements come together in their game. Playtesting is absolutely crucial to the design process, because it tells a designer where the game is engaging, where it is boring, frustrating, or confusing, and where mechanics are having unintended effects on the dynamics, aesthetics and outcomes.

An Example of How to Apply MDAO

In order to create effective interventions, MDAO is used in conjunction with an understanding of the literature on effective behavior and attitude changes in the specific domain of the intervention. Figure 2 illustrates this process where decisions regarding each step are supported by research findings reported in the literature. The MDAO design process from start to finish is presented through a hypothetical example where an agency is commissioning an intervention aimed at improving cardiovascular health using a serious game.

Figure 2. The process by which MDAO is applied



The Mission

Having a clear mission statement is important to any project. The mission in this example was decided by the agency commissioning the intervention, based on their research and goals.

Mission:

- Improve lifelong cardiovascular health.

Choosing an Intervention

When creating interventions, it is important to identify and focus on an appropriate target audience and be as specific as possible about the objectives of the intervention. From research, it is known that long-term cardiovascular health is important to a wide range of quality of life concerns, especially in aging populations. In the last 20 years, American women, more than other populations, have shown declining cardiovascular health. Due to this, women are the most at-risk group. New research shows that lifetime cardiovascular health is linked to physical activity in youth. From this literature, experts have concluded that it would be useful to design a game for young women that will improve their lifelong cardiovascular health.

Intervention:

- Improve lifelong cardiovascular health in women by promoting physical activity in young women.

Choosing Outcomes

The Outcome for MDAO must be very specific. Research shows that long-term heart health is improved through young people participating in varying types of exercise. A highly beneficial type of exercise for cardiovascular health that even very active young people tend not to get enough of is frequent short bursts of high-intensity activity over the course of an hour. Therefore, it will be the goal of this intervention to cause frequent short bursts of high activity with an aim to improve overall cardiovascular health.

Outcome:

- Frequent short bursts of activity over the course of an hour.

Choosing Aesthetics

It is important to consider who the players are, what kind of themes are likely to resonate with them, and what has been shown to motivate and engage this population. Research shows that young women are more motivated to engage in physical activity with the emotional support of their peers, and are also motivated by difficult tasks and feedback about how much they are improving.

Aesthetics:

- Fellowship.
- Challenge.

Choosing Dynamics

The desired Dynamics of the game should support both the Outcomes and the Aesthetics. The type of exercise desired for the Outcome can be achieved by running with varied intensity, especially if frequent changes of direction are required as well. Research shows that, for young women, collaborating with others creates strong social bonds, and competition against opponents is an engaging type of challenge.

Dynamics:

- Collaboration.
- Competition.
- Running and stopping.
- Sprinting back and forth over a short distance.

Choosing Mechanics

Mechanics that will cause running include: time pressure, distance between goals, and limited ways to get a ball across a court. Mechanics that will cause players to stop or change direction include: allowing players to hinder each other's movement, switching quickly between offensive and defensive roles, and giving players limited space. Playing the game in teams gives players an opportunity to collaborate. Opposing teams provide players a challenge that can adjust and scale with their ability level. Complicated scoring mechanisms provide players with skills to hone and opportunities to develop strategies.

Mechanics:

- There are two opposing teams.
- Only one team can win.
- The team with the most points at the end of the allotted time wins.
- Points are scored by putting the ball through the goal.
- Goal is a hoop high up on a pole.
- Each team is aiming at a different hoop in the opposition's territory.
- A shot must be made within 24 seconds of gaining possession of the ball.
- Players cannot kick the ball.
- Players must bounce the ball while moving.
- Hoops are placed at either end of the court.
- The court is 94 feet long.
- Players can intercept the ball.
- Possession of ball immediately results in offensive play.
- Players can physically block others as long as the blocking player is not moving.
- There is a 48 minute timer for the game.

In this example, MDAO has been used to create a game very much like basketball, with a specific outcome as an intervention for young women aimed at the larger mission of improving lifelong cardiovascular health.

FUTURE RESEARCH DIRECTIONS

To strengthen the case for serious games over game-based interventions with clinical outcomes, it would be useful to study the efficacy of clinical interventions that use either intrinsic or extrinsic motivations with the same stated outcomes, because most of the research on intrinsic and extrinsic motivation has been done in other fields. Longitudinal research on the lasting effects of serious games in clinical practice would show how much of an impact serious games have after the intervention is finished.

CONCLUSION

This chapter has outlined several tactics for going beyond gamification and creating effective interventions through designing serious games. These tactics include: promoting intrinsically motivating interventions by meeting the definition of a game; creating in-game goals that are distinct from the desired real world outcomes; understanding how to engender learning, self-efficacy, and behavior change; identifying the desired outcomes for the intervention; and using MDAO to target games toward creating the desired outcomes. The specifics on these tactics are reviewed below.

Promote Intrinsic Engagement

This chapter has shown that games are a successful medium for interventions, thanks to their ability to create motivation through intrinsic engagement. Sustained engagement is one of the key elements in the long-term effectiveness of clinical interventions. Many designers who seek to take advantage of this fact misunderstand the way that games generate such enduring engagement. When extrinsic rewards are added to an experience, as many designers have taken to doing, participants can perceive these rewards as a form of control being exercised on them. This puts the players in a mindset of resistance, negatively affecting their motivation toward the behavior that the intervention was meant to train. Correctly implementing the elements of a serious game in an intervention allows the player to maintain a lusory attitude. In this state, the player sees their actions as voluntary and enjoyable, rather than controlled or coerced. This enjoyment of the activity for its own sake is what makes games so engaging. When this intrinsic engagement is achieved in the context of a clinical intervention, the player will continue the intervention much longer, and be more likely to continue desired behaviors after the intervention is finished.

Give Players In-Game Goals

Ensuring that players have in-game goals that are distinct from real life outcomes is an important part of making an effective serious game. Maintaining a lusory attitude is a major part of establishing the intrinsic engagement that makes games such powerful motivators. When a player's attention is focused on the real world outcomes of a serious game, it can break down the elements of separation, unproductivity, and make-believe that contribute to a lusory attitude. It also becomes for them another type of extrinsic reward, and, like other extrinsic rewards, eventually becomes a negative influence on the player's motivation. A designer can avoid this, and continue to promote intrinsic engagement, by making sure that the player has clear in-game goals that they can focus their attention on.

Tailor Challenges to Create Flow

The ability to draw players into a state of flow is one of the most powerful tools that games can bring to clinical practice. Being able to create flow is not a necessary part of making a serious game, but it does represent a design that excels in all of the attributes that make up a game. Flow is also the pinnacle of in-the-moment intrinsic engagement and enjoyment, and the pleasure of the flow experience contributes greatly to the player's continued engagement and enjoyment of the game. Furthermore, while a player is in a flow state, they are in a very positive frame of mind, and will take risks and attempt challenges that they would otherwise not. This means that the player is not just more engaged, but also learning more quickly and effectively. Designing a game that gets players into a state of flow can be very difficult, because it requires that the difficulty of the challenges in the game be balanced to the skill level of the player. This is easiest to achieve in adaptive games, where the difficulty of the game can change in response to the performance of the player. In games where adaptive difficulty is not possible or appropriate, it is still possible to facilitate a flow state by being conscious of the skill levels of players while designing challenges.

Apply Behavior Change Theories

In many interventions, the ultimate desired outcome is a change in the behavior of the participants. When designing games that include behavior change in their outcomes, it is important to understand the mechanisms of behavior change. One of the most common mistakes that designers make is to conflate education with behavior change. Increasing knowledge, awareness, or recognition can be a useful step towards changing a behavior, but that greater understanding is not enough to alter behavior. The theory of planned behavior states that intention is one of the most significant predictors of positive change, and lays out three factors that strengthen intention toward a behavior. The first is subjective norm, or the perceived social opinion of the behavior. The second is attitude, or the person's own opinion of the behavior. The third factor is perceived behavioral control, also called self-efficacy, which refers to the person's belief in his or her own ability to make a change in the behavior. Increasing a person's knowledge and awareness can influence the first two factors, but increasing self-efficacy is more difficult. The best way to instill self-efficacy is to have the person make the change in a way that they perceive as being free from real world consequences. This is one of the reasons that games are such powerful tools for changing behaviors. Games are free from real world consequences by definition, and so provide an excellent safe space for people to practice new skills and behaviors, and build the self-efficacy that leads to real behavior change.

Understand Messaging Psychology

Messaging psychology is another useful tool for serious game designers to study. The most powerful example comes from studies done on methods used to convince people to quit smoking (Hansen et al., 2010). When gruesome images were used as scare tactics, the images evoked in the participants feelings of fear about their own mortality, but those feelings of fear failed to achieve the desired changes in behavior. On the contrary, the participants who were subjected to the gruesome images actually increased the amount they smoked, because it was a comforting act. It is important that serious game designers make themselves aware of the challenges presented by messaging psychology, and make use of the best techniques available to them.

Use Games to Teach

Games have a great potential as pedagogical tools. Many serious game designers have underestimated this potential in the past, and made games that are used as assessments of prior knowledge, rather than as ways to teach, build skills, and change attitudes. Games are capable of facilitating learning in many ways. The clear goals inherent in games provide a strong system of feedback that helps players evaluate their own skills and understand the effects of their actions as they play. The lusory attitude that games encourage, and the flow state, if it is achieved, increases a player's willingness to experiment, creating additional opportunities to learn and making players more comfortable and adaptable with the skills and knowledge that they are using. The intrinsic motivation that keeps players engaged with a game over a long period allows them to benefit from other effects, including a spiral curriculum design and distributed practice, both of which are effective at building mastery and automaticity in essential skills.

Identify Game Outcomes

Before creating a serious game, game designers must make a clear decision about the desired outcomes of their game, so that the rest of their design choices support that decision. Games can be very effective at achieving a variety of outcomes, but they can't achieve outcomes that are beyond the scope of their design. Serious game designers frequently make the mistake of failing to fully question and identify their desired outcomes. This leads to situations where, for example, a game that was meant to change the behavior of its players instead educates them about the behavior without taking any additional steps toward behavioral change. Even if the game is very successful at educating its players, it has still failed to achieve its intended outcome. A serious game is not limited to a single outcome. Game designers that seek to make behavioral changes will often find it helpful, or even necessary, to educate their players. But each outcome must be planned and designed for in order to be effective. To help serious game designers become better at identifying their desired outcomes, seven essential types of outcomes have been identified.

Seven types of outcomes

- **Behavior Change:** Creating a change in behavior that continues after the game.
  - "*I am now exercising for half an hour a day*."
- **Attitude:** Changing attitude towards particular activities or ideas.
  - "*Exercise is fun*."
- **Information:** Raising awareness, transferring facts, sharing knowledge of the subjective norm.
  - "*Exercising 15 min a day has implications for longevity*."

- **Self-Efficacy:** Supporting perceived behavioral control, and building the player's confidence in their own ability to accomplish a specific task.
  - "*I can do it*!"
- **Explicit Skills:** Learning specific methodologies, algorithms, and meta-cognitive skills, gaining a conceptual understanding of a topic, or becoming proficient at performing a task.
  - "*I now know proper running technique*."
- **Implicit Skills:** Building executive function, memory, reasoning, and problem solving ability.
  - "*I can now critically reason about my health choices*."
- **Aesthetic:** Inspiring emotions in the play as they play the game.
  - "*I feel close to the other people I played this game with*."

Implement Game Design Practices through MDAO

The goal of the MDAO framework is to help serious game designers understand the elements that make effective and engaging games, and apply that understanding to the task of making effective serious games as clinical interventions. The Mechanics, Dynamics, and Aesthetics (MDA) framework breaks down the interactions between the components of an engaging gaming experience, and outlines best practices for entertainment game designers. It expands the MDA framework to include Outcomes, in order to better suit the needs of serious game designers. MDAO encourages serious game designers to follow practices that are successful at creating engaging entertainment games, while accounting for the necessity of including real world outcomes. The recommended process for designing a serious game begins with understanding the nature of the desired outcomes for the game. It progresses by adding aesthetics, then dynamics, and finally mechanics, each of which is designed to support the decisions made in the previous levels of design. This ensures that the desired goals are not lost or mistakenly altered during the design process, and reduces the risk of implementing mechanics or dynamics that could interfere with the desired outcome.

The MDAO framework, in conjunction with playtesting and the background presented in this chapter, should function as the basis for creating better serious games that are more engaging and more effective at creating serious outcomes.

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KEY TERMS AND DEFINITIONS

Aesthetic Outcome: An outcome wherein an emotional response is elicited from the subject.

Attitude Outcome: An outcome wherein the subject's attitude or opinion toward particular activities or ideas is altered.

Behavior Change Outcome: An outcome wherein a lasting effect is created in the subject's behavior.

Explicit Skills Outcome: An outcome wherein the subject learns the use of specific methodologies, algorithms, or meta-cognitive skills, gains a conceptual understanding of a topic, or becomes proficient at performing a task.

Game: A separate, rule-based activity that the participant freely engages in with a lusory attitude.

Game-Based Intervention: An intervention that is aiming to use game elements to increase motivation.

Gamification: The process of applying an extrinsic motivational framework using elements found in games, such as points, badges, and leaderboards.

Implicit Skills Outcome: An outcome wherein the subject's executive function, memory, reasoning, or problem solving ability is improved.

Information Outcome: An outcome wherein awareness raising, transferring of facts, or imparting of knowledge of a subjective norm occurs.

Intervention: A program, activity or experience designed to promote specific health, or other, outcomes.

MDAO: Mechanics, dynamics, aesthetics and outcomes, a design framework for serious games using MDA as its basis.

Outcome: The intention of a serious game or intervention.

Self-Efficacy Outcome: An outcome wherein the subject's perceived behavioral control is increased, building the subject's confidence in their own ability to accomplish a specific task.

Serious Game: A game that has explicit outcomes that go beyond entertaining the players.