Towards Minimalist Game Design

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ABSTRACT

In this paper, we describe a design methodology that we have termed *Minimalist Game Design*. Minimalist games have small rulesets, narrow decision spaces, and abstract audiovisual representations, yet they do not compromise on depth of play or possibility space. We begin with a motivation for and definition of minimalist games, including terms such as "rules," "mechanics," "control," and "interface," and illustrate the importance of artificial design constraints. Using a number of examples, we show the strengths of minimalist game elements in systems, controls, visuals, and audio. Adhering to these constraints, we have designed games that feature a small set of mechanics and one core mechanic, while still being sufficiently deep and allowing for player exploration and performance. This depth comes from procedural methods, combinatorial complexity, probability, obfuscation, challenge, or any combination thereof. Our methodology embraces principles of holistic design, where there is no "filler," and where every element of the game contributes to the play experience in some meaningful, deliberate way.

Categories and Subject Descriptors

K.8.0 [**Personal Computing**]: General – Games

Keywords

videogames, minimalism, games, rules, mechanics, holism, design, core mechanic

1. INTRODUCTION

Game design has arguably experienced a shift from traditional systems design to technology-heavy user experience design. While early videogame minimalism was a technological necessity [22], labor and time are currently often the limiting factors that lead to minimalist design tendencies for small, independent game developers. We believe that self-imposed, deliberate constraints on both the design process and game are an important component to exploring new types of games and play.

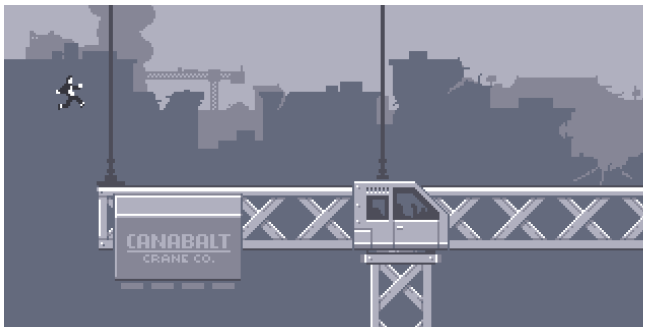

Figure 1: The one-button game *Canabalt*

To this end, we introduce the notion of *Minimalist Game Design* as a general design principle, and we attempt to define the cultural space of minimalist games. But first we must ask: why minimalism? Why exploratory game design under minimalist constraints? What makes this model compelling to both designers and players? The following list is not exhaustive, but we have isolated some of the key properties of minimalist games. Specifically, we would like to craft minimal aesthetics, sets of rules, and game mechanics that

- lead to an interesting, tractable set of player choices, and (potentially) vast possibility spaces,
- have only few, simple controls that integrate with the mechanics, and may map to a variety of input devices,
- can be rendered in simple, aesthetically pleasing, and understandable visual styles,
- can be enhanced by sound effects and music that resonate with the design thematically,
- and create a space that the player can perform in and explore.

All of these point to choosing a few powerful, evocative elements, and then exploring the design space they constitute. Ideally, this keeps the design space tractable for the creator and the resulting game accessible to a wide variety of players.

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There are strong indications that we have yet to discover the vast space of compelling games and game mechanics, and we believe that taking focused, small steps in this direction makes the space more tractable. The essential question is "how much is enough?", and while we can't answer that question, we will attempt to take some steps in that direction. Instead, we are exploring new ideas and deliberately avoiding retreading the known – unless it is for the sake of leveraging *knowledge in the world* [25]. Note though that, unlike the artistic movement of the 60s and thereafter, our form of minimalism is not polemic. Ours is an alternative design process. It is intended to be descriptive, not prescriptive or normative.

2. MINIMALISM, GAMES AND DESIGN

Minimalism is broadly defined as "a style or technique (as in music, literature, or design) that is characterized by extreme spareness and simplicity," [1]. It is also a belief in architectural studies that "simple forms will free people from the everyday clutter." [10] Minimalism sports several catchy slogans, such as: "less is more," or "doing more with less," or "less but better." Across all disciplines, the idea is to strip away all unnecessary components, leaving only the parts one really needs. In different fields, this means different things. In architecture, it means working with simple, possibly flat surfaces and relying on lighting to add beauty. In music, minimalist artists like Philip Glass create short, simple melodies called motifs and repeat them over and over with minor variations to create a larger piece. In the visual arts, minimalism is perhaps at its most extreme, Piet Mondrian's primary-color grid compositions serving as the classic example.

The goal is not just to strip away the unnecessary parts but to highlight and perfect the necessary elements. It's similar to the idea of embracing "quality over quantity." If a creator has limited resources and wants to create something of quality, then the quantity or capacity of the featured aspects must be adjusted to compensate.

A minimalist game is deliberately abstract. Note though that abstraction is not equal to minimalism in game design; abstraction merely *facilitates* minimalism. While a minimalist game is abstract, an abstraction in itself need not be minimalist. For example, the control icon overlays in the Playstation 3 game *Heavy Rain* are clearly abstractions, but the related controls are not minimalist, nor is *Heavy Rain* a minimalist game.

Ideally, abstraction in a minimalist game, be it systemic or visual, leads to a low *perceived complexity* of the game, which makes the game more accessible. But this does not imply that the *systemic complexity* of the game is shallow at all. On the contrary, some minimalist games are exceedingly deep. The design challenge lies in exposing the most necessary elements of a complex system to the player.

Our form of minimalism is not limited to aesthetic analysis [24]. Minimalist game design is as much about understanding minimalist games as it is about the minimalist design process: placing constraints on the design space. We will elaborate on this throughout the paper, but one prominent example is the 1-button constraint – using only a single button as the player control – imposed for submissions to the *Gamma IV* showcase at the Game Developers Conference 2010 (Fig. 2).

Figure 2: Minimalist logo for the 1-button game event *Gamma 4* at GDC 2010.

Minimalist games are about choice, like other games, but not the vast choice of, for example, the board game *Go*, where the opening player has $19^2 = 361$ possible moves. Of course *Go* has a minimalist aesthetic, but the perceived complexity is not minimalist. So, is *Bejeweled* a minimalist game? For a board of dimensions $x \times y$ the player has $(x-1) \times y + (y-1) \times x = 2xy - y - x$ potential gem swaps. So, on a 5×5 board there are a maximum of 40 possible swaps, but due to numerous gem colors and clever randomization, only few of these swaps are valid and form lines of ≥ 3 identical gems in any given turn. Thus, *Bejeweled* can be seen as a minimalist game from the view of constrained, interesting choice and depth of play [13].

It must be made clear though that a minimalist game is not necessarily a *casual* game [12]. While this might hold for Bejeweled, it is clearly not the case for a rather difficult, dexterity-based 1-button game such as *Canabalt* (Fig. 1), which, while accessible, also contains elements of non-casual racing and obstacle course games. Similarly, *Galcon* is a minimalist real-time strategy (RTS) game that is clearly not casual [15]; however, games that rely heavily on complex level layouts and art asset creation might not be considered minimalist, even though they are casual. As such, a minimalist game can be either casual or "hardcore." Or, in other words, the labels *casual* or *hardcore* are not defining features of a minimalist game.

A characterizing feature of a minimalist game is *minimal controls*, or as others have put it, *amplification of input* [8, 34, 18], where small player effort can lead to large changes in game state. Modern action games often use every available control the hardware has to offer (analog/digital sticks and buttons), which can be confusing. We believe that much of the expressive power of videogames comes from said input amplification, and we do not consider mimetic, 1:1 mappings in games such as *Dance Central* to be minimal. Minimal control schemes have a tendency to map to a wide variety of input devices and platforms, while mimetic interfaces are mostly tailored to special purpose hardware.

It is important to point out that the controls are not necessarily the mechanics, or, in other words, the controls might not have a 1:1 mapping to the underlying mechanics that they trigger. Pressing the same button might have different effects depending on game state or spatiotemporal positions of game elements. This is often used to great effect in minimalist games, and is referred to as *context-sensitivity*.

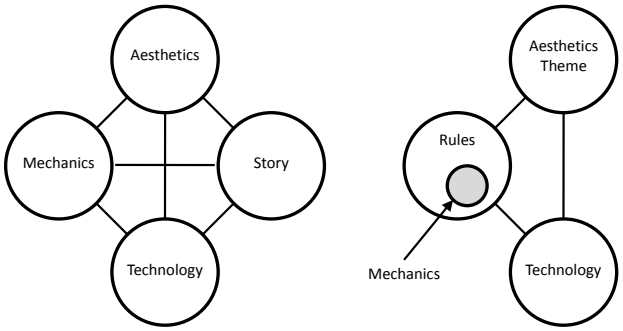

Figure 3: Schell's Elemental Tetrad of traditional game design [30] (left) and the triangle of minimalist game design (right).

Minimalist games have *theme*, not explicit narrative. The player experience, or even a story that the player might share after a game session, emerges from the theme, aesthetics, rules, and mechanics. Given this definition, *Space Invaders* has theme, not story. Schell's *Elemental Tetrad* [30] becomes a Triangle in our setting (Fig. 3).

Theme need not be explicit. On the contrary, it might be highly ambiguous. The theme in the real-time physics-based game *Osmos* is "ambient space." The interpretation thereof, whether it represents the cosmos or a petri dish is (mostly) left to the player. *Canabalt*, on the other hand has a strong, explicit theme, even though the player is always left guessing what the protagonist is actually running from. Thus, even explicit theme can contain deliberate omission. We see this as the videogame equivalent to what Scott McCloud calls *the space between the panels* [20]. Minimalist game creators select only those specific elements that are necessary to communicate the most important aspects of their idea, and they let the players, through the process of closure, fill in the rest of the scenario with their imagination, creating a diegetically detailed and rich play environment that does not require a team of artists.

Constraints are important. When given the chance to do anything, there is a strong temptation to do nothing. Constraining the decision space is one essential key to making the design and play of games interesting. Many artists artificially constrain themselves; examples of this would be haiku and Oulipo [6]. In our experience, intelligently placing constraints on the *design space* is more likely to result in a compelling, minimalist game.

Minimalist games often have limited scope, which allows a small team to shape the experience. There is a saying in the design world: "A camel is a horse designed by committee." Another popular phrase is simply that "too many cooks in the kitchen spoil the dish." In cinema, we have the idea of Auteur Theory [29], or the importance of having a director who is the main author of the piece. Many popular minimalist games were made by relatively small teams, often with one main creative voice behind the steering wheel.

Technology in the traditional sense, while still important for a minimalist game, takes on a lesser role than is generally the case in game development. In a minimalist game, design, technology arises from focus on rules and mechanics that result in deep, complex, and interesting systems and resulting system dynamics, as well as procedural methods to generate systems, levels, visuals and sounds.

Deep gameplay can result from coupling simple system elements (hitpoints, remaining time, size, etc.) such that interesting choices and trade-offs arise. While tight coupling is seen as a bad thing in the field of software engineering due to the combinatorial complexity of large software systems [21], it becomes manageable for a small number of rules and mechanics and can lead to interesting outcomes. Tight coupling can help add complexity to the game system without the addition of new game elements, as explained in Section 3.1. This is not to be mistaken with Ian Bogost's tight coupling between a game's abstract mechanics and its fiction or skin [5].

3. THE ANATOMY OF A MINIMALIST GAME

Since we adopt the definition of mechanics as a true subset of the game rules (Fig. 3), it is necessary to begin with a few definitions. Seen from a high level view, all games consist of

- **Space.** This is the allowed spatial range of play, which could be a board, a room, a city, or an n-dimensional metric space in a digital game, possibly with attached state variables and boundaries.

- **Entities.** These are the moving, malleable, stateful objects in the game. For example, the pieces of a board game, where state might be tied to its spatial position and other quantities (life, speed, size, etc.).

The entirety of the game state at any instance in time is encoded in all entities and their state, plus the state of the play space.

While this might seem terse, it allows us to make a distinction between rules, mechanics, control, and interface, such that we can thoroughly analyze the structure of (minimalist) games (Fig. 4).

- **Rules** define all state changes/transitions in the game, no matter whether these result from the passage of game time, a player/agent action, or any other means.

- **Mechanics** are a subset of these rules that might be dependent on the game state, and can be (directly or indirectly) invoked by the player/agent through the controls.

- **Controls** are the direct manipulation (hardware) actions provided to the player. Controls are generally distinct from mechanics in that, for example, pressing the same button twice might result in a different outcome based on the current game state.

- **Interface** is the entirety of the input/output feedback loop. As such, the controls are one element of the interface, along with the audiovisual feedback provided by the game.

This definition of mechanics is similar to that provided by Miguel Sicart [31], where "Game mechanics are methods invoked by agents for interacting with the game world," yet differs in that Sicart argues for an ontological distinction between mechanics and rules. Hunicke et al. [11], consider

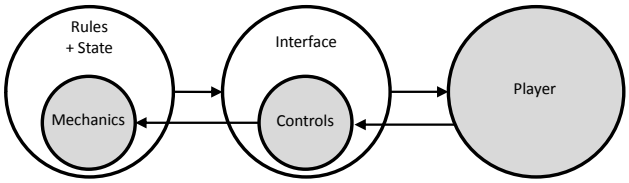

Figure 4: Games are first and foremost a set of rules, with which the player interacts through the provided interface. Some of the rules, the mechanics, are designed such that the player can use them to manipulate the game state through controls, which are one element of the game interface.

all rules as mechanics, whereas Schell [30] defines the rules as one of six different game mechanics (rules, space, stateful objects, actions, skill and chance). These conflicting definitions motivated us to formulate our own definitions, such that they map to the space of minimalist games.

Mechanics are often described on multiple levels. There are the overarching *game mechanics*, with expressions such as "a race against time" or "become the biggest." Then we have the *core mechanic*, which is what Salen and Zimmerman define as "the essential play activity players perform again and again in a game," [28] examples being "click to propel the player mote" or "collide with smaller objects to absorb them" in *Osmos*. And finally, there are the mechanics that govern every atomic player choice, such as "eject mass."

We have chosen a two-level description: micro and macro. The micro-view allows us to separate all individual micro-mechanics that, together, form macro-mechanics. From the macro-view, we tend to describe game mechanics as human-recognizable activities. Let's take *Osmos* as an example. In the basic "ambient" mode, if the player does not interact with the system, the rules of the simulation still apply, and the overall game state changes constantly. Once the player invokes a mechanic through the controls, the player (mote) position and overall game state changes. The only micro-mechanic in the game is "eject mass," which is a result of the controls "position mouse in 2D" and "click mouse button." The rules of "create equal and opposite impulse" to both mote and ejected mass, as well as "large absorbs small" are merely rules in a strict sense, but they influence the timing of the "eject mass" mechanic, thus, rules and game state have an influence on the nature of the "eject mass" mechanic. When looking at the macro-mechanic of "eat to grow," we need to look at a sequential combination of micro-mechanics. This can be seen as the *core mechanic* of *Osmos*.

Our definition of *rules* and *mechanics* maps to Salen and Zimmerman's definitions of *constituative rules* and *operational rules*, respectively [28]. Sicart [31] convincingly argues that mechanics are performative, while rules are normative. This definition is congruent with our macro-view, in that the player decides the order and timing of the micro-mechanics, which can be seen as player/agent performance.

This definition of micro- and macro-mechanics is essentially a simplified version of human motion control [36]. Simply stated, even the most seemingly trivial human motion consists of many atomic tasks, most of which are subconscious, and with the exception of trained teachers, we tend to describe them on a high level. In minimalist game design, the goal is to allow for high-level activities (core mechanics) that consist of a small set of rearrangeable micro-mechanics.

Overarching *game mechanics*, useful for high-level design discussion, can be a combination of core mechanics and other rules that are not directly related to any player-invoked mechanic (time pressure, chance, etc.). This strays from Sicart's definition [31], but it is often used in the literature, and it is added here as an attempt of achieving completeness. Differentiating between *mechanic*, *core mechanic*, and *game mechanic* is likely to lead to ambiguity, but this is a flaw we are currently willing to accept and that we will hopefully be able to remedy in the future.

With all that said, we now make an attempt to list the defining features of a minimalist game. Minimalist games

- have a small set of rules,
- contain only few micro-mechanics and possibly only one (macro) core mechanic.
- may have tightly coupled elements and/or (sub)systems,
- have simple, easy to use controls that blend with the underlying systems,
- are systemically and visually abstract,
- have a low perceived complexity but (possibly) deep systemic complexity.

A crucial question with minimalist games, and games in general, is that of which parameters to balance/tweak during the iterative design process. These can be exposed in all areas, whether system, control, visual, or aural. The following sections illustrate some unique features of minimalist games with respect to these and other aspects.

3.1 System

The basic idea of designing a minimalist system, is to provide a small set of interesting, consequential choices that lead to deep and compelling gameplay. Norman considers Chess to have a *wide and deep* structure [25], and the same can surely be said about Go: while minimalist in aesthetic and rule set, the number of possible choices per turn are overwhelming for novices. Minimalist games intelligently narrow down the possible choices, while not compromising on the depth. Depth in this case can either be the associated decision tree, the gradual acquisition of a dexterous skill, or any other insight providing mechanism.

Naturally, this is a delicate balancing act in that offering only a few choices might make the game too simplistic. In some cases, system properties might be adjusted to make a small set of choices compelling. A good example of this can be seen in *Canabalt* (Fig. 1). Essentially, the player has three choices: "jump short," "jump high," and "do nothing" (the latter, while counterintuitive, can be useful in many situations). The key ingredient to making this interesting is *urgency*; the fact that the player character is always running, and his speed is increasing. This calls for split second decision making, and thus the small set of only three choices is made more compelling. Although deliberate collision with crates slows the player down, *Canabalt* does not have a deep decision tree. Depth in *Canabalt* comes from a state of flow, in which the player can seemingly anticipate the upcoming structures and associated challenges. Note

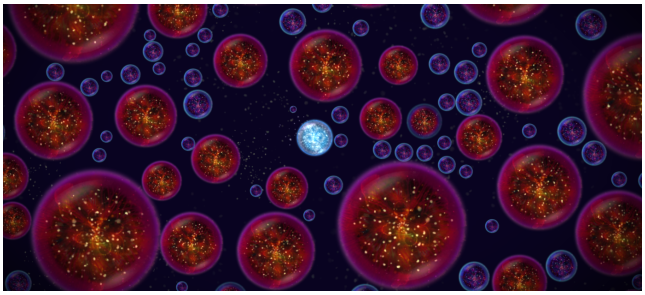

Figure 5: *Osmos* uses color coding relative to player size to signal danger: red = larger, blue = smaller.

the high-level similarity to the classic game *Tetris* with only few choices ("rotate left/right," "move left/right" and "drop). *Tetris* gradually raises the challenge by increasing the speed at which the blocks fall.

Time pressure is not the only way to make a small decision space meaningful. Another tool leveraged in many minimalist games is the notion of *tight coupling*. Tightly coupled rule systems can provide interesting decisions without adding additional objects, resources and/or parameters to the artifact – a common technique to increase complexity and depth. The trade-off lies in balancing these systems, but the payoff, ideally, is that the player will have less information to process at any given point. Tight coupling can, for example, arise from interpreting a single state variable of some entity (usually the player) in a variety of ways. *Osmos* provides a good example of this, in that the player's *size* is also *life* and *fuel*. Player size is furthermore coupled to the game state, both systemically and visually, in that objects larger than the player absorb the player (as opposed to them being absorbed) and are rendered in bright red (as opposed to blue), see Fig 5. Fuel is necessary to eject mass, change trajectory, and reach the other motes for absorption.

Interestingly, while David Sirlin initially advises against tight coupling [33], he later states that a tightly coupled system, while difficult to balance, might make for a better game if it can eventually be properly balanced [32]. *Osmos* went through many iterations of balancing and tweaking parameters of the interconnected systems, but the end result is compelling to many players. Many other examples of coupling exist, such as tying spatial position to a game parameter. *Braid* makes especially good use of this in attaching the flow of time to the player's horizontal position in some levels. In general, coupling can increase the number of trade-offs and choices to be made in a game that, initially, seems to have only few choices.

While minimalist games can rely on theme, the theme need not only emerge from its audiovisual representation. Rather, it can arise from the design of the system. Two excellent examples are *Gravitation* and *The Marriage*. *Gravitation* models "mania, melancholia, and the creative process," while *The Marriage* is an interpretation of a specific marriage. In both cases, these themes are conveyed through the system, its rules and mechanics, and are to be explored by the player. Jonathan Blow calls this *dynamical meaning* [4].

The interpretation of theme depends on a player's mental model. Norman differentiates between three mental models

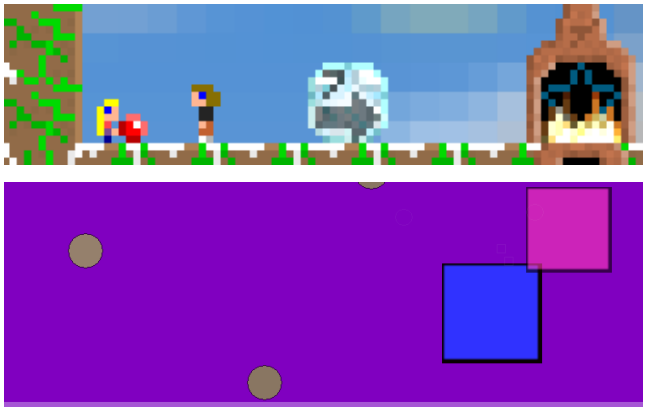

Figure 6: Jason Rohrer's *Gravitation* (top) and Rod Humble's *The Marriage* (bottom).

of systems [25]: design model, user model, and system image. In game design, the design model is entirely irrelevant to the majority of players, since the player only interacts with the system image. As pointed out by Jonathan Blow, the system always communicates something to the player, whether that meaning is intentional or not [4]. In other words, even in the theme of a minimalist game, intention on the side of the designer will likely be perceived as optional, if it is perceived at all. We believe that authorial intent is generally desirable as a high-level design goal, but that designing for a single user model is ill-fated.

Mental models should be able to support the immediate rules, to allow for easy entry. But these mental models should be encouraged to expand and be modified through repeated play and learning of the possibility space. For example, if learning the model is the goal of the game, then the systemic feedback should support that learning.

While minimalist games can have systems of varying complexity, systems that are considered deep or highly complex must have a low *perceived complexity* in order to be minimalist by our definition. Many minimalist games have low perceived complexity but deep systemic complexity. For example, the decision spaces in both *Drop7* and *Orbital* are relatively small (Fig. 7). *Drop7* gives at most seven choices in each round, while *Orbital* exhibits the one-button, physics-based placement of a circular object. Yet in both games the consequences of choice can be immense, with deep decision trees. The important design aspect is that the player need not deal with these structures when first playing these games. In other words, the combinatorial complexity – and the increasing entropy – while a defining feature of these games, is not a micro-mechanic, and need not be expertly mastered or understood to play the game. Depth in the play of these games arises almost exclusively from systemic complexity, learning a model of the game, and repeatedly validating this model against the reality of play. This is what Ian Bogost calls "puzzling the sublime." [7]

3.2 Control

Controls are the affordances of the hardware devices that players use to invoke the mechanics, set off chains of rules, and trigger state changes in the game (Fig. 4). Control is an integral part of the overall user interface (UI), the other part being the audiovisual representation of the game, which we'll

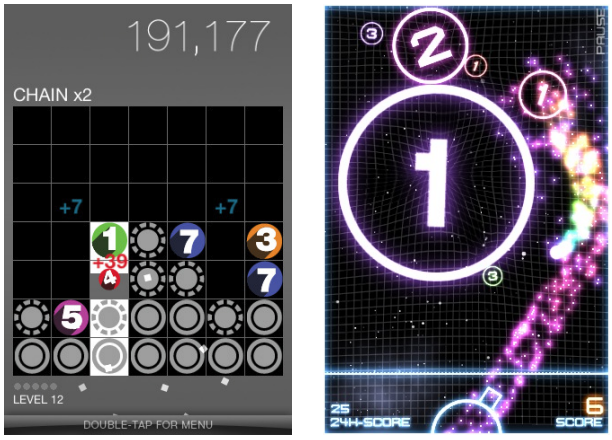

Figure 7: *Drop7* (left) and *Orbital* (right).

address further below. Designing the controls of any game is generally a trade-off between functionality and simplicity; increase the number of controls (buttons, sticks, etc.), and one increases functionality while reducing simplicity. Minimalist games tend to leverage complexity in the system, not in the controls – and especially not in an overpopulated UI. For example, *Street Fighter* and *StarCraft*, while excellent and deeply competitive games, have controls and UIs that are complex and surely not minimalist. Jesper Juul argues that "it is rare to find a clear-cut border between interface and gameplay," [14] and while we generally agree with this statement – and it clearly holds true for both *Street Fighter* and *StarCraft* – it becomes easier in our definition of a minimalist game. We make a conscious attempt at simplifying controls, such that they become accessible to a wide variety of players.

Simplifying the structure of tasks is a cornerstone of game design minimalism. In our setting, this means simplifying the structure of mechanics and thereby how they map to controls. A common method of simplification is mapping a high dimensional input signal to a lower dimensional projection. For example, in *Canabalt*, potentially less-used inputs were simply removed from the design. Even without extensive play testing, we think it is obvious that, given the premise of being chased from the left of the screen, it is likely that otherwise common controls such as "move left," "move right" and "run" would be in almost constant "move right" and "run" position.

We have found categorizing games by their controls and related audiovisual feedback to be helpful in understanding their inherent structure. While this is not specific to minimalist games, input and output (i/o) discretization is of special interest to us. Turn-based games such as *Drop7* and most non-digital games have purely discrete i/o. The entirely discrete nature makes the controls nearly transparent, and challenge is introduced through combinatorial structure, hidden information, and stepwise increasing entropy (Fig. 7). Of course, games have varying levels of spatiotemporal discretization, and there exists a continuum between "perfectly discrete" and "entirely continuous" (an example of an entirely continuous game would be any contemporary first person shooter). Of course, given that we are operating on digital computer hardware, *any* game is discrete. Our notion of discrete is whether the game is spatiotemporally *perceiveably* discrete, and a game that operates in floating point coordinates and updates the game state at 30-60 frames per second can be considered to be continuous.

Tetris is somewhere between the two extremes, in that both space and time are discretized to some degree. *Osmos* on the other hand uses discrete clicks to eject mass, but requires continuous positioning of the mouse, and is a continuous quasi-physical simulation. Still, we consider this input scheme to be minimal. It is interesting to contemplate whether *Osmos* would be a more accessible game if it had four discrete ejection directions, such that it would map well to a commodity game pad, thereby making the input scheme entirely discrete. The beautifully abstract *Everyday Shooter* uses this scheme to limit the possible firing directions to four while allowing for continuous placement of the avatar. *Super Mario Bros.* has four discrete binary inputs ("left," "right," "jump" and "run"), but since its underlying system is entirely continuous, it allows for significant player expression [34]. This is another instance of how micro-mechanics can be creatively rearranged to form performative macro-mechanics.

The key insight here is that it can be exceedingly helpful to analyze the control scheme of a game as discrete/continuous input/output, and to use the level of discretization as a balancing/tuning parameter. In our experience, discrete schemes have a tendency to be more accessible and map to a wider variety of hardware devices.

3.3 Visual

A minimalist game is visually abstract, meaning that its visual representation is non-photorealistic, at most [27]. More often though, visuals in minimalist games are nonrepresentational, with various degrees of independence from visual references in the world [2]. Much like a well designed infographic [3, 35, 19, 17], or even a masterfully reductionist piece of art, the (system) state, or a suitable mapping thereof, should be interpretable from the visual representation. While this arguably complicates utilizing knowledge in the world, and might require some additional explaining and tutorial, it comes at the advantages of increased artistic and systemic freedom, and reduces the complexity of the required art.

Unfamiliarity with abstract rendering can be intelligently counterbalanced with signs and symbols that have some connection to the world. This reduces to using simple shapes with varying sizes and colors, such that a clear mapping between these basic properties and the game state can be established [1]. But even the simplest connections such as color matching can be sufficient to establish this mapping. In *Eliss* the player merges and splits circles of the same color to reach a target radius of that specific color, remove the circle, and progress toward the end of the level (Fig. 8, left). If circles of different color overlap for too long, the game ends. Creating a mental model of this system is extremely simple, yet challenges such as gravitational wells and the economy of space allow for a compelling game with an ambiguous, playful theme.

These mappings can be further reinforced with animations that communicate game state. An especially impressive example of this can be seen in the Heider-Simmel demonstration [2] [9] (Fig. 8, right). Even though the visual style shares

[1] the study of these cultural sign processes is known as *semiology* [3].

[2] http://www.youtube.com/watch?v=sZBKer6PMtM

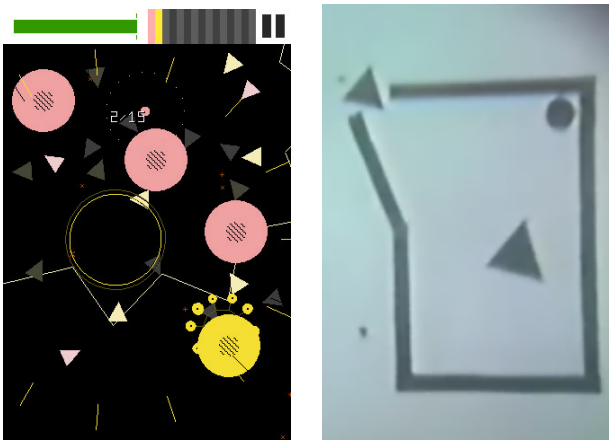

Figure 8: *Eliss* (left) and the Heider-Simmel experiment (right).

similarities with *Eliss*, the elements of the animation clearly communicate the act of chasing each other and expressing familiarity and hostility with one another.

Player attention is a limited resource, and it will be directed towards whatever the player deems most interesting, informative, and aesthetically pleasing. Since this cannot be predetermined by the designer, and might vary strongly between players, sparsity in visual representation can be a powerful tool. The design challenge is to choose which of the underlying system states to render, such that the player can form a mental model of the game system through the act of play. The principle is similar to *encapsulation* in object oriented programming (OOP): only a narrow interface is exposed to the programmer, and the inner workings that are not necessary for using the code are hidden. This is a balancing "knob" with which the designer can decouple perceived complexity from systemic complexity. According to Norman, the "complexity of appearance seems to be determined by the number of controls, whereas difficulty of use is jointly determined by the difficulty of finding the relevant controls (which increases with the number of controls) and the difficulty of executing the functions (which may decrease with the number of controls)." [25] Thus, the game designer must carefully balance the number of elements on screen and their spatial arrangement, while making their function clear enough to understand.

As an example, in *Osmos* the coloring of the other motes (circles) in red or blue *relative* to player size tries to communicate the rules of the system, while the ejected piece of matter + particles, as well as the propulsion and shrinking effects communicate the mechanics.

We have observed two other beneficial aspects of using abstract visuals: coherence and contrast. These two seemingly disjoint properties can be merged harmoniously in temporal media such as videogames and computer animation. David OReilly's short film *The External World* is an impressive instance of such work [26] where almost entirely different designs are combined into a masterful whole (Fig. 9). This specific kind of amalgamation is only possible in the abstract, and it creates interesting contrast. Contrast is the equivalent to a high-entropy and information laden signal, and it is one key motivator for player exploration and "figuring out the system." In comparison, it is inherently difficult to achieve a comparable level of coherence in photorealistic

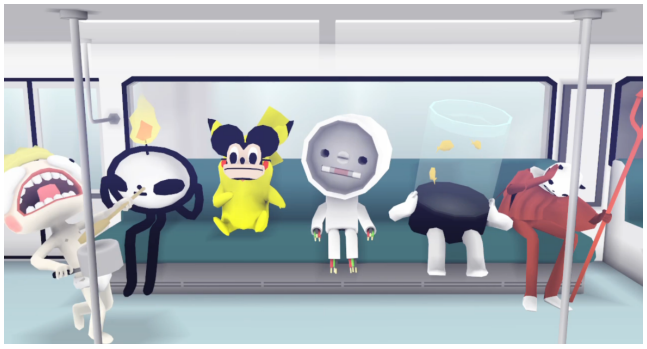

Figure 9: David OReilly's *The External World*.

representation, where all elements of animation and rendering must match to avoid the uncanny [23, 16].

While outside of the scope of this paper, many minimalist games rely heavily on procedural methods for any form of content creation, be it entities or the entire game space. Examples include but are not limited to L-Systems, Poisson sampling, and Perlin Noise. Instead of using a level editor, *Osmos* uses procedural methods to create and populate individual levels as a function of level type and number.

3.4 Aural

In a minimalist game, music is often designed to reinforce theme while sound effects enhance salient game events, such that game state is communicated through multiple, potentially redundant channels. Audio can be intrusive, helpful, or deliberately obfuscating, but no matter which purpose the audio serves, it should be deliberate and used judiciously. *Osmos* uses minimal, mostly low-frequency electronica music to set the theme, with matching, event driven sound effects to communicate absorption and collision with the boundaries. The event sounds have a higher pitch than the elements of the music, which makes them stand out from the overall soundscape. Alternatively, *Everyday Shooter* uses event driven sound effects that blend seamlessly with the background music, thereby allowing the player to craft the soundscape and set the theme as part of the play performance. In *Canabalt*, the audio is designed to enhance the theme and provide the game with a touch of grandeur – to make the game world feel larger than it actually is.

4. CONCLUSIONS AND OUTLOOK

Our definition of minimalist game design – and minimalist games – is just one way of framing the game design and analysis process. And while easy to confuse as such, it is not intended as dogma, manifesto, or polemic. We have made an attempt at describing a set of loosely defined constraints, such that both the process of game design, as well as the actual play of the game, are focused on a single core mechanic and the playful exploration of the implied possibility space. Given the current critical and commercial success of such games, we would argue that the minimal aesthetic of early videogames, induced by very real hardware constraints, was abandoned too soon in favor of modern day techno-fetishism. This is not to say that there is no inherent value in technological advances, but there are still many aesthetic forms to be discovered in the small.

In 1988, Norman stated the following: "Computer graphics are used more for show than for legitimate purposes. Their powers are wasted. But there exists great potential to make visible what should be visible (and to keep hidden what is irrelevant)." [25] Two decades later, this statement still holds for a vast majority of contemporary videogames. We believe that a wide variety of styles, rules, and aesthetics are what keeps games interesting, and, ideally, helps us figure out what it means to be playful and human. The minimalist aesthetic can help us in determining the most relevant rules, mechanics and representations of a system, while still providing for an intractably large possibility space that can be explored, better understood, and used as a device for interpersonal communication in form of play.

Janet Murry, author of *Hamlet on the Holodeck* has the following to say: "Innovation in representation allows us to point at and devote our shared attention to things that were invisible or unshared before." We strongly believe that minimalism is and will continue to be an important piece in reaching said innovation in representation, and we look forward to the next leaps in creativity and insight.

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