Finding Meaning in Abstract Games: A Deep Reading of Sage Solitaire

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ABSTRACT
This paper presents a methodology for discovering and explaining how games with very few thematic assets (or abstract games) are meaningful to players through rules and dynamics. Through the process of implementing play strategies as computer code, and then running simulations of the game being played, insights about how a player might think about and experience playing the game are revealed. These insights are compiled into interpretations of the themes and meanings that can be found in the abstract game. The paper then applies the methodology to perform a deep reading of the single player digital card game *Sage Solitaire*.

Keywords
Procedural rhetoric, game interpretation

INTRODUCTION
Increasingly, games are becoming culturally accepted as meaningful parts of the human experience. Games are being created about subjects such as immigration, work/life balance, globalization, and more. This trend makes good on the promise that games can change and enrich our understanding of the world and, finally, don't just have to be about running, jumping and shooting things. While exciting, most social impact games adopt the idea that games must represent their subject via instantial assets (text, images, sounds). This paper presents a methodology for discovering and explaining how games with very few thematic assets, or abstract games, are meaningful and can be about subjects.

This methodology builds upon the game studies and design perspective that treats games as unique because they invite players to explore *playable models*. By reflecting upon interactions, game players are able achieve unique system–level understandings of these systems (Bogost 2007). Abstract games, such as Solitaire, Poker, Mancala, Tiddlywinks, etc. cannot fully be argued to be a model of anything in the real world, yet they are still playable systems that produce aesthetic experiences for players. Because they don't present concrete representations of subjects, their themes, meanings, and representations, are left implicit and only exist in the player's experience. Game designer Clint Hocking claims that games "mean via their dynamics (Hocking 2011)." Taking that claim very seriously, this paper presents a methodology for the interpretation of abstract games that helps discover and describe what those dynamics are and where they came from.

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The methodology presented in this paper first involves having the interpreter gain familiarity with an abstract game, and then has them concretely specify a model of how an imagined player would play it. This model is then implemented as computer code, and simulations of the game are ran. Through reflection about the development process of the modeled player, and the results of simulations, unique insights are provided about the gameplay dynamics. With these insights, arguments about themes and meanings can be made.

This paper then applies this methodology and presents a deep reading of *Sage Solitaire* – an abstract digital single player card game (Gage 2015).

MEANING IN ABSTRACT GAMES

In order to understand a game with little or no instantial thematic elements, it is necessary to understand what *is* present. The following process for understanding games is inspired by proceduralist readings (Treanor et al. 2011) and the Mechanics, Dynamics and Aesthetics (MDA) approach (Hunicke, Leblanc, and Zubek 2004). These approaches arguably privilege a game's rules and dynamics over their thematic assets which makes them useful for abstract games that have little to no thematic assets. This approach can be contrasted with the sociological, cultural, or historical readings of games. The proceduralist perspective attempts to reduce the influence of such factors toward better understanding how games *uniquely* function as a representational medium.

Understanding abstract games involves deeply understanding a game's rules and dynamics and then attaching those elements to aesthetic human experience. Getting access to a game's rules is often a matter of simply following a tutorial, or in the case of non-digital games, reading the rules that are provided with the game. While some digital games withhold some rules from players as part of their design (e.g. discovery games such as *Zendo*), it is considered good game design practice to make the rules of a game transparent to the player (Johnson 2014).

A game's dynamics are the phenomena that occur when a game is played. In thematic asset-light games, dynamics are often the obstacles encountered, and the strategies applied, to win the game or maximize score. In contrast to a game's rules, dynamics are much harder to concretely understand. In fact, it can be argued that they cannot be definitively arrived at all, as they are individually determined by players, and players are embedded in the irreducible systems of history and culture. However, dominant strategies and common play styles do persist across many players, and interpretation need not rely on objective claims. Much can still be learned by making assumptions about what sort of dynamics a player might encounter. Though, insofar as a dynamic is relevant to an interpretation, it will only be as convincing as the player choices that lead to it are considered reasonable.

After an understanding of the rules and dynamics is reached, the next step is to attach descriptions of human experience to them. This stage is the entire point of interpretation. As abstract games have no diegetic story arcs, soundtracks, cut scenes or imagery, the aesthetic experience of playing the game can be argued to be *the meaning* of the game. In his Game Developer's Conference presentation "Life and Death and Middle Pair: Go, Poker and the Sublime," Frank Lantz asserts that games can "make thought visible to itself (Lantz 2011)." Using Poker as an example, Lantz argues that Poker is fundamentally *about* greed. And through playing, "Poker translates greed into something like poetry." Without relying on instantial assets, Poker is able to create an aesthetic experience that people all over the world find meaningful.

Game designer Clint Hocking claims that games "mean via their dynamics" (Hocking 2011). Lantz's interpretation of Poker takes a similar stance, though he only describes high-level descriptions of these dynamics, rather than precisely where they come from. If dynamics are the message, we need to be able to better understand what the dynamics are and how to create them. The ultimate goal of this approach is to provide a method for illuminating how rules and dynamics create experiences. With this understanding we can better appreciate and design meaningful dynamics in games.

Below is a methodology for helping an interpreter step away from familiarity and reveal and discover what experiences and meanings a player might get from a game. This level of understanding enables us to make more rigorous arguments about games and why people play them.

CODE AS THEORY

In "Build It to Understand It," Michael Mateas and Andrew Stern present a mode of inquiry where a practitioner *implements theories* from fields (such as game studies), and embeds the implementations in artistic artifacts; the overall goal is to better understand and build upon the original theory (Mateas and Stern 2005). This practice echoes cognitive scientist Johnson-Laird (who echoed AI researchers Simon and Newell) who wrote "There is a well established list of advantages that programs bring to the theorist: they concentrate the mind marvelously; they transform mysticism into information processing, forcing the theorist to make intuitions explicit and to translate vague terminology into concrete proposals..." (Johnson-Laird 1981).

This paper proposes an interpretation method for abstract games with few instantial assets that involve implementing both the game and a theory of how to play the game as a computer program. Through implementation, intuitions about a game are turned into concrete assertions about how a player reacts to a game's dynamics. By following the trace of how the model of the player makes choices, an interpreter is provided with a list of dynamical phenomena from which interpretive claims can be made, as well as a window into precisely what processes created them.

While similar, this method of interpretation differs in goal from the type of player modeling found in the field of artificial intelligence in games. In their "Inclusive View of Player Modeling" Smith et al. categorize much of the work in this field into four facets: domain (where the data that shaped the model came from), purpose (to generate behavior or to describe it), scope (the breadth of who the model can be said to be modeling), and source (what techniques created the model) (Smith et al. 2011).

The goal of the interpretive methodology presented in this paper is to use computational techniques to inform a humanistic understanding of how players experience games and how we can interpret them. This puts the approach as falling between many of the facets. While the method does involve creating a model, the model exists to aid in interpretation rather than generate *or* describe behavior. All forms of data and processing methods are permissible to influence the model (domain) and the validity of the model (scope) is only as strong as those who are convinced that the model reflects a player. However, this paper does point to the potential of using existing player models to enrich our understandings of the game for which they model players.

Other related areas of scholarship are the computational and mathematical study of games. Particularly with card, dice, and simple board games, AI researchers deeply explore and even "solve" games. Solving games involves proving that a strategy will always create an optimal outcome for the player. While valuable, knowing an optimal strategy does not help us understand how humans can and do experience playing a game. Furthermore, the precise techniques for computing optimal strategies are often sharply distinct from how humans think about and experience making strategic choices. For example, computing the best decisions in Chess often involves changing the representations of the board and state space to improve performance.

On the other hand, merely surveying expert human players doesn't give a precise window into how Chess' rules and dynamics shape experience. This is because expert players' ability is derived from years of acquired tacit knowledge.

THE METHODOLOGY

The following methodology is intended to produce a humanistic understanding of abstract games. While aspects of it may be relevant to story/theme rich games, it would not be appropriate to apply this approach and not acknowledge the themes and experiences produced through instantial assets. Also, it is not meant to produce scientific conclusions about games and their players as, like other methods of interpretation, it is heavily subjective and informed by the interpreter's worldview and play experiences.

This methodology produces insights that are not available without implementing the game at an algorithmic level. This points to a possible conclusion that only people who understand computation can deeply understand the dynamical meaning of abstract games. This should not be particularly shocking as abstract games are often deeply systematic, and involve computational thinking. Of course, this methodology only produces one type of understanding. Other approaches for interpretation are obviously important for fully understanding these kinds of games! This interpretation method is geared towards those who are interested in either high-level play, or in creating abstract strategy games.

The following is a description of four stages that provide evidence and insight into what an abstract game is about and how it achieves that representation.

Stage 1: Implement the Game

The first stage of interpretation involves clearly understanding the rules of the game through implementing the game in code. The following stage will involve creating an artificial player of the game and running the programs together. As this method is premised on the assumption that instantial assets are not of significance, the implementation need not attempt to replicate them. For example, most would agree that the symbols on standard card decks (e.g. Queens, Spades, etc.) are not relevant to the high level strategic choices of the players of games like Poker.

In some games, the rules are not readily available or can only be inferred. In this case, the interpreter must extract and make commitments about the rules. While these "reverse engineered" rules may not be completely accurate, the interpreter's ability to extract rules reflects how the rules are able to be experienced, and thus should be considered part of how the game exists in the world. In other words, if a rule is so opaque or misleading that a player never experiences it, it should not be relevant to interpretation.

Also, it should be noted that accessing the game's actual code is not relevant to the type of interpretation described in this paper. While readings of code have technical, historical and cultural significance, the goal of this method is to understand how human players experience the themes of a game.

Stage 2: Implement a Player

The next stage is to implement a simulated player for the game. In creating this player, the interpreter will effectively be creating a *theory* of how the game can be played. This will involve making concrete commitments as to how a player thinks about the decision space, how the player makes choices, how a player thinks about strategy over time, what strategy even is, and more.

Uneasiness may be experienced in making these commitments, as computer code is more stringent than human thought. These moments, and the associated commitments, are key to the interpretation as they capture parts of the experience of playing that are not documented through implementation. These situations should be noted for analysis.

Different from most artificial intelligence players of games, the interpreter should strive to avoid using the aid of sophisticated computation in choosing actions. The goal is to implement a particular strategy that a human player can use. For example, while a Chess playing program may transform the state space of the board and pieces, and then use complex planning techniques to make an optimal choice, a human player could likely not. Instead, an implemented player for Chess might have a comparatively limited ability to plan ahead and may rely on memorizing strategies associated with configurations of pieces (as Chess strategy books often describe). However, to a certain degree this cannot be avoided. These differences in the abilities of the imagined human player and the implemented player should be noted for analysis.

Stage 3: Simulation

Next, the simulated player can "play" the game and the interpreter can begin to recognize patterns and note what experiences playing the game produces. Through running simulations, the interpreter is placed in the mode of a spectator rather than a player. From this stance, and from being the author of the modeled player, the interpreter is in a good position to recognize and make note of what the experience of playing would be like.

Note that simulations can be run choice by choice or many games at a time. By playing the game many times, aggregate information can be gathered. Furthermore, if the game involves randomness, setting a fixed random seed and iteratively tweaking the simulated player's strategy can also provide useful perspectives on how changing strategy affects the experience of playing the game. These should be noted for analysis.

Stage 4: Analysis

Figure 1 – A screenshot of *Sage Solitaire*.

At this point, the interpreter has implemented the game, implemented a theory of how the it should be played, noted how the player thinks about choices, noted places where the concrete nature of code forced commitments to particular strategies, observed the game being played turn by turn many times, and noted observations about what the experience of playing the game would be like. From this, specific dynamics of the game, and thus the experience of playing it, can be extracted through analysis. In this stage, the interpreter can make informed conclusions about the themes and meaning in the game.

THE MEANING OF SAGE SOLITAIRE

Below is an interpretation of *Sage Solitaire* (Gage 2015). Through implementing a simulated player that responds to the rules and dynamics, themes, and arguably the *meaning*, of the game are revealed. Of course, the conclusions drawn are subjective and limitless as other interpretations are possible.

Sage Solitaire, created by designer/developer Zach Gage, is a single player digital card game released for iOS. This interpretation will focus on the "Single Deck" version of the game (though those not familiar with the game are encouraged to take a look at the "Vegas" and "True Grit" modes). As the game clearly explains its rules in a tutorial, the first stage of implementing the rules is not difficult. Also, Gage released the rules online so that the game could be played with a standard set of playing cards[1].

In *Sage Solitaire*, the player attempts to earn a high score by making hands from a standard 52-card deck. The game initially presents the player with three rows of three piles of cards. The top row piles have eight cards each. The middle row piles have piles of seven, six and five cards. The bottom row has piles of four, three and two cards. Using the top card in each pile, the player can make hands similar to those in Poker (e.g. pairs, flushes, straights, etc. See figure 2). A hand is only valid to be played if it has cards from two of the rows. When a hand is played, the player is given an amount of points (figure 2) and the cards from the hand are removed from the piles, revealing the next cards.

The player is also given the ability to "trash" a card (i.e. remove it from a pile) up to two times in a row. In each game, a random suit is chosen, and hands that use that suit are awarded double points. Large bonuses are given if the player is able to clear all 52 cards and the game is over when there are no valid hands to be made and the player cannot trash any cards.

For the sake of this interpretation, not much will be made of the implementation of these rules. Though, if the game did not thoroughly explain the rules, this stage would have involved making concrete commitments about them.

The next stage of interpretation involves creating a simulated player. This stage concretely specifies how a player thinks about making choices, and ultimately chooses among them.

This model of a *Sage Solitaire* player assumes that players are striving to maximize their score (which is the implicit goal of the game). Score is accumulated by making hands, and the more rare a hand is, the more points it awards (see figure 2 for a table of all possible hands and their associated scores). This model assumes that players will look at the available cards (nine at the start of the game, but fewer as piles are depleted), and strive to make the hand that will award the most points. Furthermore, as hands that contain the bonus suit receive double the hand's score, the player will also try to maximize the number of hands that contain the bonus suit.

Those two goals may conflict with one another, as the player may be able to make a high scoring hand and also be able to score a hand with a bonus suit. To resolve this, the player model compares the high scoring hand's score to twice the lower scoring hand's score and chooses to play the hand with the higher score. While this is an arguably obvious strategy, it is the first of many dilemmas and decisions with which the game confronts the player. From even that simple strategy, it can be asserted that *Sage Solitaire* is partly *about* this sort of conditional decision-making.

The reader may think this claim is obvious and present in all games. However, abstract games *amplify* these sorts of experiences. Playing *Sage Solitaire* involves staring at the screen and struggling with these choices. The "right" choice is not obvious, and cannot be known due to the random shuffling of the cards. The heuristic described above is the first

[1] http://sagesolitaire.com/SageSolitaireStandardRules.png

Figure 2 – The valid hands and scores for *Sage Solitaire.*

instance of uneasiness encountered by modeling this player as it is not always the right choice.

Even before the player can compare the hand's scores, they must be able to collect the possible valid hands for comparison. Recall that a valid hand must be made up of Poker-like hands and contain cards from two rows. Hands of *Sage Solitaire* are made up of either two cards (a pair), three cards (three of a kind or a three card straight), four cards (four of a kind), or 5 cards (a five card straight, flush, full house or straight flush). In order to collect all possible valid hands, the player needs to check all combinations of two cards to see if there is a pair and contains cards from two different rows. Then, the player must look at all combinations of three cards and see if there is either a three-card straight, or three of a kind, and contains cards from two different rows. And so on for the four and five card sets of cards.

The ability to look at a collection of objects and choose all possible sets of a certain size is a matter of understanding combinatorics. Combinatorics, a well-studied mathematical subject, is also very important to everyday life. *Sage Solitaire* requires that players perform this task constantly.

Another point of uneasiness comes from implementing the algorithm for the computational player model to iterate through all possible combinations, as humans are not so inherently systematic. Staring at the screen searching for these hands is central to the experience of playing the game. Through simulation, it was found that, on average, there are between five and six hands available at the start of each game (not including the possibility of trashing each of the nine cards). The experience of playing the game is much more intuitive and in each turn valid combinations are almost certain to be missed.

Once a hand is played, the cards are taken away from play. This can affect the player's strategy significantly as those cards may be part of a higher value, *partially formed,* hand and once complete that hand could result in a higher score. For example, while four cards of a suit do not form a complete hand, it may not be a good idea for the player to use any of those cards for a hand that scores lower than a flush, as the odds of revealing a fifth card of that suit are fairly high. Strategic players of *Sage Solitaire* not only need to consider as many complete hands as possible, but also the partial hands. Through simulation, it was found that on the first turn the player is confronted with, on average, 22 partial hands that are one card away from forming a valid hand (for the remainder of this interpretation partial hands will refer to hands that are one card short of being complete).

Playing *Sage Solitaire* involves confronting the difficulties of searching a large space of combinations and identifying these particular sets of cards. This is a difficult task for humans, and grappling with this is a core theme of the game.

Another element that affects decision-making is that the piles can deplete, and thus the number of cards available to form hands in the future is smaller. A poor strategy depletes piles too early and raises the chances that there will be no hands available and the game will end with a low score. Thus, the player has an incentive to create hands using cards from the larger piles.

The player may also choose to trash a card in hopes of completing a partial hand with the newly revealed card. However, trashing cards (which can only be done twice in a row) can also negatively affect the player's score, as doing so can remove a card that may have later significance. Additionally, the pile it is in will become smaller or empty.

A player could track which cards have been removed from play and only trash ones that are unlikely to aid in the future. For example, if three 2's and all four 3's have been played, the player could fairly safely trash a 2, as it can no longer contribute to a straight (though the suit of the 2 may still contribute to a future flush). This card counting is very difficult for humans to perform, and thus it was not implemented in this particular model. Again, confronting this inability of human players is central to what the game is about.

At this point, there are five potentially conflicting factors that influence which of the many hands should be chosen:

1. The hand's score.
2. Whether or not the hand contains a bonus suit.
3. The extent to which a hand would deplete a pile.
4. If the hand would remove the possibility of being able to play a high scoring partial hand in the future.

5. Whether or not to trash a card in hopes of completing a high scoring partial hand.

As noted earlier, these factors conflict, and as a player, it is not clear which hand is optimal. The experience of playing the game involves mulling over these factors and making informed guesses.

The implemented player presented here resolved this dilemma by producing a numerical utility value for each of the hands and choosing the hand with the highest value. This value begins as the hand's score, and is modified by a bonus or penalty for each of the remaining factors. Note that the magnitudes of the bonuses and penalties are a representation of the relative significance the player places on each of the factors. The particular magnitudes are determined by the following processes:

If the hand contained a bonus suit, the utility value is simply increased by 20% (the bonus suit bonus).

To account for the degree to which choosing the hand would deplete piles, the difference between the largest pile and each of the piles that the cards of the hand are from is summed. This value, increased by 50% (the depletion penalty), is subtracted from the utility value. This makes hands with cards from large piles have very small penalties, and hands with cards from the smaller piles have larger penalties.

To account for the partial hands that the particular hand may be detracting from, the type of the hand is compared with all other possible partial hands. If the hand would detract from a flush, full house, five card straight, or a straight flush, the utility value for the hand is reduced by 20% (the partial hand penalty).

Finally, to determine whether the player should trash a card, the top card in each pile is considered as a hand. If a high scoring partial hand is present, and removing the card from play would not detract from a high scoring complete hand, the "trash" hand is given a utility value of the score of the highest scoring partial hand completed reduced by 25% (the trash score modifier).

With an implementation of both the game and a model player, simulations can be used to tweak the model and provide insight. One major piece of insight is being able to find out how the implemented strategy works in aggregate as well as how often various significant phenomena occur. As the goal is to gain insight about the experience of playing the game, the strategy's performance is not of primary significance as long as it is able to achieve relatively similar scores as the interpreter. If the strategy achieved average scores drastically above or below those to which the interpreter could achieve, it is an indication that the interpreter did not actually implement an approximation about how they think about the game, and they should revisit the player implementation.

Through simulating the player playing the game thousands of times, this implementation achieved an average score of 517. The highest score of the simulation was 890. Other notable statistics that were gathered are that the strategy tended to clear all of the cards 5% of the time, and out of all hands, the model chooses to take the trash strategy (hoping to complete a partial hand) 46% of the time (only succeeding 19% of the time). This suggests that the trash strategy, as implemented, does not pay off very often (even after tweaking the magnitudes of the bonuses and penalties). Based on the interpreter's experiences of playing the game, the success rate seems lower than expected, however it may also be the result of intermittent excitement producing an inflated sense of efficacy for this strategy.

Based on this information, *Sage Solitaire* can be argued to be a game about conditional decision making, combinatorics, and ultimately, economics. In making choices, complete hands can be understood as consumption goods. Players use hands to earn points and as a result they deplete piles that do not replenish. Partial hands are capital, as in time they may produce complete hands. When the player trashes a card and it doesn't succeed, they immediately consider the counterfactual of what might have happened. Like in economics, making these strategic decisions involves considering the counterfactuals. *Sage Solitaire* is about making decisions in an uncertain environment, carefully considering the factors that differentiate hands, staring at your mobile phone, and taking risks and regretting and celebrating them.

CONCLUSION

Abstract games are some of the most played games and they are too often dismissed as mere distractions (or traditions). Contained within abstract games are experiences that deeply reflect important aspects of the human experience. There is much work to be done in understanding how to talk about, appreciate and create aesthetic experiences in games, abstract and otherwise. The methodology and interpretation presented in this paper is hopefully a step in the right direction.

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