

Let's Play Our Way: Designing Flexibility into Card Game Systems

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**Abstract**

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In this dissertation, I explore the idea of designing “flexible game systems”. A flexible game system allows players (not software designers) to decide on what rules to enforce, who enforces them, and when. I explore this in the context of digital card games and introduce two design strategies for promoting flexibility. The first strategy is “robustness”. When players want to change the rules of a game, a robust system is able to resist extreme breakdowns that the new rule would provoke. The second is “versatility”. A versatile system can accommodate multiple use-scenarios and can support them very well. To investigate these concepts, first, I engage in reflective design inquiry through the design and implementation of Card Board, a highly flexible digital card game system. Second, via a user study of Card Board, I analyze how players negotiate the rules of play, take ownership of the game experience, and communicate in the course of play. Through a thematic and grounded qualitative analysis, I derive rich descriptions of negotiation, play, and communication. I offer contributions that include criteria for flexibility with sub-principles of robustness and versatility, design recommendations for flexible systems,

novel dimensions of design for gameplay and communications, and rich description of game play and rule-negotiation over flexible systems. A model of rule-negotiation is introduced as well as advancements in theory regarding unexpected use of software and socially-negotiated play.

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## Epigraph

*It is a highly valued function of society to prevent changes in the rules of the many games it embraces... Deviancy, however, is the very essence of culture.*

*James P. Carse, Finite and Infinite Games*

# 1 Introduction

It is not always relevant to compare digital media against their analog counterparts, but when an activity acquires a different tenor in its digital version, we can look closer to learn more about design for digital media. I will make such a comparison regarding one activity of everyday life: card games and computing.

As a long-time gamer, my informal observation of digital games is that rigid mechanisms in the system often push the playfulness of the game out of corners where it commonly dwelt. To play a digital game can translate into an exercise in optimizations and selfish algorithms. There may be playfulness still, but it has moved from its original locale.

Let me share a scenario. A mother begins to teach her daughter how to play cribbage. There comes a time when they have to be away from each other for a while, so Mom does some research. She figures that they can play over the internet, maybe on Yahoo! games, an online service. She logs into the system only to find that Yahoo! Cribbage is overwhelmingly different than cribbage at home. Scores are tallied automatically; the computer makes decisions for you; and players pressure each other to play quickly. After examining the game and watching a few matches, it is easy for her to decide not even to sign her daughter up for an account. The mother-daughter cribbage games, until they see each other in person, have been canceled. What makes Yahoo! Cribbage so different than cribbage at home?

The specific question that I ask is borne of the natural comparison between cards and digital-cards; and, it is what leads me to the term “flexibility.” With a deck of cards, players have access to a diverse range of actions, including simple ones such as cheating, sharing, and waiting.

Alternatively, Yahoo!'s Cribbage interface deeply restricts such activities. When flexibility is desired, how can it be built into a digital system?

In this dissertation, I introduce and explore the idea of designing flexible games by which I mean digital game systems that can accommodate rule-changing and rule-bending. I use “flexible” primarily as an adjective to the digital system. When applied to the nouns “game” or “game system”, I mean to say that that game or that system supports rule-changing and rule-bending.

An example of rule-changing occurs when families play cards together. While playing the card game, UNO<sup>®</sup>, families may negotiate variations to the rules, retract moves, and be a little more lenient with younger children. These actions depend on a gaming medium that is capable of supporting revisions. With most non-digital games, this is possible because the enforcement of the rules is in the hands of the players. Changes and exceptions depend on social agreements that are arranged in the moment. For computer-mediated games such as Microsoft Hearts, rules are often embodied by the machine and, subsequently, cannot be bent.

In this dissertation, I bring together findings, principles, and design guidelines from human computer interaction, from computer-mediated communications, and from game studies to create a set of criteria for flexible games, a definition of flexible design, and a set of dimensions for discussing and evaluating the design of game systems. I have created a flexible, digital card game system to address my stated research goal. I employ user studies of this system to inform my claims about designing for flexibility.

## 2 Domain: Card Games

In this dissertation, I have designed and built a flexible digital card game. Digital card games are playing card games that are played over a digital medium. They are usually a digital adaptation of analog card games such as Hearts, Solitaire, Poker, and Bridge.

I chose card games because of the widespread adoption of the playing card. The standard 52-card deck with four suits and 13 numbered cards is the basis for a large set of games. The Pagat card-game website (McLeod, 2011) indexes over 700. A pilot survey of the Finnish population in 2007 (Pauliina, Kirsikka, & Frans, 2007) reports that 66% of the population play traditional games (board and card games) and 31% play digital games. In that survey, of the top-reported *digital* games, three are versions of traditional games. Mahjong (#10) and online poker (#8) are two on the list; and, the highest-reported digital game is Solitaire (#1), appearing on 12% of all respondents' self-reports, out-ranking the second-highest game on the list by a wide margin (Sims games, #2, 7%). An older study of card-playing in the United States (Crespi, 1956) finds that 57% of Endicott, NY played cards at the time, matching existing statistics circa 1956 that placed card-playing at 56% nationally. Thanks to the popularity of card games, I can design the empirical portion of this dissertation with confidence that users will be familiar with the flexibility of the card medium. Furthermore, I will be able to compare that against expectations for the flexibility of computing-media.

### **2.1 Related Substantive Areas (Board Games, Table top computing)**

Board games such as Monopoly, Scrabble, and other European strategy games or 'eurogames' (S. Woods, 2010), such as Settlers of Catan (Mayfair Games) or Dominion (Rio Grande Games), although not directly studied in this dissertation, have close ties to traditional card

games. (Eurogames are hobbyist table games that are “relatively short games with accessible themes, simple rules, constrained playing times and a strong emphasis on comparative performance through non-confrontational interaction.” (S. Woods, 2010, p. 40))

Like card games, analog versions of board games are socially-mediated and flexible. Their digital counterparts face the same challenges in translation as discussed in this dissertation (Pape, 2012). Due to these strong parallels, much of my work is informed also by research on board games. Hence, my findings will transfer almost directly into the domain of board games.

I have chosen not to develop my design for tabletop computing devices which have horizontally-mounted touch surfaces for people to gather around and interact with. A study using a tabletop device immediately draws attention to the unique qualities of the device and its form-factor. As such, the novelty of tabletop devices may introduce complicating variables to the user study. My general approach to flexibility will inform design decisions made for devices like the Microsoft PixelSense but also for a variety of contexts: tablet devices, mobile computing, video game consoles and traditional desktop workstations or laptop computers. The role of computing technology for leisure will be examined in the familiar keyboard, mouse, and windows paradigm. This will allow me to concentrate on the question of flexibility in digital games.

## ***2.2 From Analog to Digital Card Games: A Case for Flexibility***

In my introduction, I described a mother who wanted to play cribbage with her daughter online. She found the digital version inadequate despite it being presented as the same game. In this chapter, I elaborate on these challenges of digital translation and explain what flexibility offers for digital incarnations of card games.

To make the general phrase “analog to digital” tractable, I review empirical research on analog games and compare that with research on existing digital games such as Yahoo! Games or prototypes that have been play-tested by users. This review relies less on conceptual theories and more on empirical studies. The literature is divided into three topics, as informed by the following. Crespi (1956) identifies three primary motivations for playing cards: to gamble, to compete, and for social inclusion. Similar contrasts (skill vs. sociability) can be found in research on board games (d’Astous & Gagnon, 2007; S. Woods, 2010). In practice, these motivations are often intertwined. For now, I will begin analyzing these motivations separately. After this three-part review, a summary appears at the end of this section that includes a discussion of what has been ‘lost in translation’ from analog to digital and what role flexibility can play as a solution.

### **2.2.1 Motivation: Gambling**

The popularity of online poker sites testifies to the success of the digital translation of gambling games. Empirical study (Wood & Griffiths, 2008) of profit-minded gamblers shows behavior that takes advantage of the technology to control identity (e.g., presenting as female to gain psychological advantage), to play multiple tables at a time, and to use the technology to antagonize other players through chat or by playing at a slow pace. It appears that general issues with the digitization of gambling games are the risk of cheating or online crime (McMullan & Rege, 2010) and lower barriers to problem gambling for addicts (Ng & Wiemer-Hastings, 2005).

### **2.2.2 Motivation: Skill**

An ethnography of a group of home poker players (Zurcher, 1970) provides a picture of a regular set of friendly poker players who play in a focused manner, eschewing frivolous conversation in favor of an environment focused on skilled competition. Zurcher classifies them as skilled players, citing Crespi. In addition, Zurcher emphasizes the idiosyncratic nature of the group

(unique norms for socialization and custom rules of play) and the way that the game-time is secluded from daily life. These players:

- relished a safe place to compete
- “showed skill” to each other : demonstrating skilled play, complimenting each for it<sup>1</sup>, and verbally recounting an impressive actions (an instant replay of sorts)
- immersed themselves in the tension of play
- enjoyed the permission to skillfully deceive each other
- created a “micro-institution” with verbal rituals, rules of irrelevance, and behavioral taboos
- preferred skillful play more than winning by chance (e.g., unskilled play is holding on to one’s hand of cards, hoping against the odds to get a good card when a strategic appraisal recommends that quitting is the wiser option)

The same skilled play-ethic can be found online. McEwan et al.’s (2012) analysis of the card- and board-game site, PlayOK, reflects a communicative pattern that implies that their players are also seeking a similar, skill-focused game session. They list four characteristics of social interaction on PlayOK:

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<sup>1</sup> “It’s a beautiful thing to see a guy play a hand of poker well. It’s better, of course, if you are the one who’s doing it, but it’s still nice to watch somebody else make a good bet, play his cards right, and then win. I don’t like to lose, but if I’ve got to lose, I’d much rather lose to someone who’s showing some skill in the game than to somebody who just steps into it.” a participant’s quote from Zurcher (1970).

- *No time to talk* – Game turns happen on the order of seconds. 72% of these gaming sessions in the data had no chat messages at all.
- *Game moves as conversational turns* – e.g., taking a trick in Euchre is also a communicative statement, to raise a bid serves as a message of challenge to other players. In established circles such as Chess, the opening moves in a game acquire depth and nuance, implying an expected stratagem or tone for the remainder of the encounter. This is known as the book (Christian, 2011); or, in electronic sports, the meta-game (Wagner, 2007)
- *Game structures replace social conventions* – “The game interface provides mechanisms that render unnecessary certain kinds of conversations that are used in the real world to organize a game session. For example, the interfaces for games in PlayOK list the players and place them in locations at the game table, meaning that the players do not need to ask each other’s names or talk about who will sit where.” (McEwan et al., 2012)
- *Language barriers* – Players from different countries often cannot communicate verbally

### **2.2.3 Motivation: Social**

Social motivation appears to cover a broad population. Crespi (1956) finds that the vast majority of card-players are those motivated by social inclusion, not by gambling or for purely-skill based competition. Respondents play with friends and family, with small stakes (if money is involved at all), to foster social ties. The card game “enables them to experience the conviviality that stems from playing a game with people with whom they want to spend their leisure time” (Crespi, 1956, p. 720). For social players, group membership and congeniality are more important than expertise. Identified characteristics include:

- An air of friendliness and getting together in a group to enjoy themselves
- A game as a substitute for small-talk. Players are relieved of the demands of making conversation when topics are exhausted
- The game is an inexpensive and convenient alternative to going out
- A relaxed investment in competition. The game “converts the players into impersonal technicians; in so doing, the card game facilitates the forgetting of the personal worries and obligations.”

Woods’ (2010) survey of eurogames exhibits a close intermingling of enjoyment of the details of a game alongside social benefits. Enjoyed characteristics are:

- Certain game mechanics that are considered enjoyable by the hobbyist community
- Personally enjoyed game traits and elements
- Intellectual challenge
- In-game interaction – *“The best games are ones that require a good amount of discussion and interaction among players but not in excess ... If I wanted to play a game without talking to people I’d have stayed home and played it online. (R145)” (p. 196)*
- Tactile aspect of components
- Narrative theme of the game
- Luck or Chaos is considered unimportant in eurogames

d'Astous et Gagnon (2007) examine 'appreciation' in a survey of players' favorite board games such as Monopoly, Scrabble, and Clue. They find the determinant factor to be fantasy ("the extent to which it leads players to live a unique and uncommon experience"). It is followed by entertainment, which they describe as "the game's capacity to amuse players by allowing them to interact, to argue, to make jokes, and to have fun." They observe that "challenge" had no significant impact on appreciation of these players' favorite games. In addition, their analysis found significant impact only among male players regarding the presence of surprising moments in a game and only among female players regarding how dynamic a game felt, having few "dead" moments during the play.

Digital card games that are socially motivated can be found in online social networks such as Facebook (Sung, Bjornrud, Lee, & Wohn, 2010) which feature games such as Words with Friends (Zynga). Järvinen (2009) analyzes Facebook games in general and asserts that driving design principles are the playful qualities of spontaneity, sociability, symbolic physicality<sup>2</sup>, narrativity, and asynchronicity. Wu et al. (2011) explore two of these principles to find significant predictors. These are:

- Symbolic physicality to perceived curiosity
- Inherent sociability to perceived enjoyment
- Perceived enjoyment to continuous participation

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<sup>2</sup> Symbolic physicality is the use of game actions as symbols of human warmth such as poking.

Challenges exist in this domain. Losh (2008) reviews failed and successful social network games and directs our attention to the social dangers that are introduced by social networking functions. In this setting, digital functions such as gift-giving, invitations, and requests for reciprocation are formalized and interwoven with the in-game mechanics. This compromises the original social intent of these actions. For example, to gain an advantage in a Facebook game such as Candy Crush Saga, players must either spend real money or petition their friends for digital gifts, trading social capital for in-game benefit. Thus, Losh emphasizes that “Facebook games can cause players to risk violating social norms about aggression, obligation, proximity, and privacy in ways that sacrifice real-world friendships by engaging Facebook friends in play.” (p.6) She also warns that the limited capacity to negotiate acceptable norms of play can come with a cost. For example, vulgar words are legal in the pre-programmed dictionaries for Scrabulous (a digital variant of Scrabble); and, without “the paralinguistic cues that are present in face-to-face games, it can be difficult for players to know when they have overstepped social boundaries.”

Another social context is that of traditional games that are played just as before in-person but also augmented digitally. To date, there are a few game projects for tabletop computing devices. Mayfair Games has developed an electronic version of their board game, Settlers of Catan, for the Microsoft PixelSense. Carnegie Mellon’s Entertainment Technology Center’s Surfacescape team<sup>3</sup> has developed a proof-of-concept implementation of Dungeons and Dragons for the same device. The implementation of Dungeons and Dragons is especially interesting because the game itself is an exercise in collaborative storytelling. A player/coordinator (the “Dungeon Master”)

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<sup>3</sup> <http://www.etc.cmu.edu/projects/surfacescapes/>

freely arbitrates the gameplay and narrative arc however he wishes. This work on tabletop computing is of interest not only because of its innovation in novel forms of interaction, but also because there is a lack of research on co-located gameplay of digitized board or card games.

Pape (2012)'s project explores the effects of automation in a co-located context by translating two board games, Checkers and Pandemic (Z-man Games), into low-automated and fully-automated versions for tabletop systems. In their evaluation of these systems (Wallace et al., 2012), although players report liking the way the game automates the placement of game tokens, the following challenges surfaced:

- Automation changed the game flow

“In the physical and low-automation versions of the game, players discussed strategies as they carried out their turns. However, in the high-automation interface, players would sometimes miss automated actions (indicated by animations in the interface). This often led to player confusion, especially after complex events. Players would then need to take time to assess the game board to get ‘caught up’ with the new game state. Consequently, extended pauses occurred when, in the other two interfaces, players would otherwise be discussing strategy or taking game actions.” (p.234)

- Automation prohibits the development of house rules
- Automation “prohibits allowances made to novice or less capable players in more social settings”

- “Participants used the flexibility of the physical or low automation interfaces to make sense of the current game state, and to facilitate decision-making processes.”

#### **2.2.4 Summary: Lost in Translation**

Drawing on the above literature to answer the question, “What changes in translation?”, to start, it is clear that certain motivations can be met. There exist digital venues for gambling, skilled performance, and for sociability. The digital games exhibit similarities. The gambling and skilled-based venues offer winnings, are fast-paced, and are free of disruptive off-topic conversation. Games on Facebook offer a relaxed opportunity to create social bonds at a leisurely pace. However, digital games often fall short. Subtle differences distinguish current digital versions from their analog counterparts.

First, *the tempo is noticeably altered*. An analog game of poker may play quickly, but is a snail’s pace in comparison to online sites where professional gamblers launch multiple tables to maximize profits. A brisk rhythm is valuable in a skilled game room, but the efficient reduction of the time to take a turn has consequences for the demonstration and appreciation of skill. By speeding up a digital game, this effectively limits the appreciative audience to those who are paying attention at the right moment. This shrinking window for player awareness is also problematic in the highly-automatic version of Pandemic. Pape (2012) reports that players found it more difficult to be aware of what other players were doing. As Xu et al. (2011) have also discovered in observing board game players’ “chore-work”, the slower pace of games, as created by manual bookkeeping activities, allows players to observe one another. It gives players time to keep up with the flow of the game. In a competitive setting, it apportions time for players to demonstrate skillful play. These benefits risk getting lost when a digital game moves too rapidly.

Second, *there is a risk of in-game interaction and social connection becoming more disjoint*. In sites where there is intense in-game interaction and no conversation, one might argue that there is a game-based conversation ongoing (McEwan et al., 2012), but in comparison to the camaraderie found among Zurcher's circle of poker friends, the common case in the PlayOK site is more similar to the "Alone Together" phenomenon of massively multi-player online games (Ducheneaut, Yee, Nickell, & Moore, 2006).

On social networking sites, Wohn et al. (2010) survey users, finding that they play games to create a joint area of interest for future social interaction rather than seeking direct social interaction in the game. This is possibly affected by the stretched out, asynchronous aspect of these games where matches are played over the course of days.

Third, *the online gaming culture is densely populated, translating an intimate experience into a global service. Digital proxies for sociability are often inadequate*. The large pool of online players affects the way the game is played and, subsequently, alters the experience of a traditional game that may once have felt more surprising or intimate.

This effect is evident in Losh's (2008) concern regarding polite-ness and social networking games. The social functions in-game (e.g., "to friend", "to gift") alone do not adequately solve these social problems. In fact, taken too naïvely, the predefined social functionalities are often misleading and insensitive. And, many have been designed with a viral, profit-based design goal in mind. Consider how many Facebook games entice users to invite their friends to play the game by offering rewards and couching the request in friendly, social terms, "find an ally", "make a neighbor", or "help your friend out!".

Fourth, a uniform “game vocabulary” implies a single, standard way to play. Digital support for this further reinforces these imposed norms into the code. When players visit a large gaming conglomerate, they encounter the site’s particular culture of play, or “meta-game” (Carter, Gibbs, & Harrop, 2012), and typically must conform themselves to it instead of being able to negotiate their own style of play. Wood (2010) spends a chapter discussing how gamers self-handicap or play less aggressively to maintain a convivial atmosphere. Monolithic game systems such as Yahoo! Games reduce the amount of negotiation available. They offer limited channels for communication and infrastructural features like high score or leaderboards, making it more difficult to carve out an idiosyncratic experience of play. A parent who decides to goof off with a child may be forced to accept a recorded loss in his history of games to engage in a frivolous game.

Fifth, the digital, networked infrastructure expands the potential influences on the game, forcing all players to be aware of the capacity of their playmates to cheat (e.g., automatic Scrabble solvers are always only a click away). Numerous digital capabilities and resources are always available to users with a computer and an Internet connection. Metaphorically speaking, it is like playing a game of Scrabble where every player at the table has a copy of a Scrabble dictionary on their lap, hidden from view. Everyone knows that you have a book and that you could have looked up the word that you are now playing. Players are online with access to Google and Wikipedia during a trivia game. Poker players are aware that hacks and bots exist for the site that they are on. Scrabble players know that an automatic scrabble-solver is readily available to themselves or their opponents. Games played online cannot be totally isolated from these infrastructural features and accountability is oftentimes impossible. This is reflected in the concerns voiced about cheating in gambling, bots in competitive play, and how casual games are

experienced<sup>4</sup>. Often, the term “circle” is used in game studies to indicate an impermeable separation between the rest of the world and the game activity. The idea of a game as a protected and hedged experience was introduced by the anthropologist Huizinga (1938) and codified today as the “magic circle” by Salen and Zimmerman (2004). The boundary of the magic circle is explored in the way that games can cross into reality (Poremba, 2007). Notably, another influence on the boundary of a game is seen with online poker, digital Scrabble, and Words with Friends. In these cases, it is the new medium, the digital infrastructure, for a game that blurs the line, perhaps negatively.

These limitations are issues that can be addressed in part by the (re)design of the software. Each of these issues has some root in the design of the code, its embodiment of certain rules, culture, and values. Although a valid solution is to rely on a game designer to embed the right combination of rule, culture, and value (e.g., designing truly convivial game features), I would like to explore a solution that relies less on the guidance of an outside authority (e.g., the software designer). Instead, I mean to explore how to accomplish this by *not* embedding these things in the code, but to rely on the players’ to self-regulate and determine the tone of the game. The literature suggests that digital games are idiosyncratic practices that would be well-served by putting authority back into the players’ hands. Losh (2008) calls for designers to be aware of how difficult it is to anticipate emergent play, alternative rule sets, and new modes of

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<sup>4</sup> In a blog post, the blogger suggests that players should give their competitors the benefit of the doubt when they lose a game of Word with Friends because their opponents use obscure words. The comments that follow (100+) are filled with anecdotes about losing or being cheated on and advice on how to identify cheaters. This discussion shows how a word game acquires a different cultural texture once it is translated to an online context. (bloggermark. “Best Players Assumed to be Cheaters”, June 8, 2013. <http://wordswithfriends.net/?p=965>: Retrieved June 18, 2013)

cooperative and competitive communication. Wallace et al. (2012) call for more flexibility to support ‘house rules’ and forgiving rule-sets.

Play can exist along many divergent paths:

*Game prototyping and design* – where the players experiment with different possibilities for game design and game-play as a design exercise (Fullerton, Swain, & Hoffman, 2008)

*Emergent play* – where a simple digital play-ground can bring about complex, unpredicted social behavior (Salen & Zimmerman, 2004; Vogiazou & Eisenstadt, 2005)

*Custom, obscure, unsupported games* – as mentioned, where ‘house-rules’ are not anticipated by the designer, but are something by which the player wants to play (Parlett, 2008)

*Game tutorials, orienting, and learning activities* – learning a new game is often done by playing abbreviated versions of a game or construed game setups that illustrate how a game is to be played. Knowledgeable players who wish to scaffold others often “break” the rules of the game. (Go, Ballagas, & Spasojevic, 2012)

*Game balancing and tweaking decisions* – flexibility can allow players to adjust the game rules so that the game experience is actually more competitive and better balanced (Cheung & Huang, 2012)

*Transformative play* – expert-players may engage in transformative play (D. Myers, 2005) that transcends the original game, breaking original rules of play, and establishing new ones.

Considering play's fluidity, I would like to let the players themselves negotiate and enact their own rules, culture, and values into the card-game software. In my mother-daughter scenario, Mom *knows* what she wants. Can we build a flexible system for her where choosing a game and its tone is as straightforward as sweeping the books off the kitchen table and shuffling a deck of cards?

### **2.3 Research Questions**

My research goal is to explore a design strategy of “flexibility” for card game systems to make them capable of meeting the unpredicted, idiosyncratic needs of the players. The designs I will explore will be specifically:

1) **Design Idea 1** offers **robustness** which is the ability to support almost any game or rule that is supported by a physical deck of cards. Design 1's solution to robustness is the omission of restrictive digital rules. Inspired by physical cards, it is a simple card deck simulator that depends on the players for the social negotiation of the game rules. In this dissertation, this is called a **manual** approach because many of the chores in a game, such as dealing and playing cards, must be done without automated support.

2) **Design Idea 2** extends the **versatility** of Design 1. Versatility is the ability to be well-suited to a variety of use-cases. Design 2 explores the concept of versatility by adding **semi-automated** components so that some of the chores in a game are less tedious for players. These semi-automated components are designed to support poker games as much as possible without compromising the robustness of the design.

Given Design Idea 1 and Design Idea 2, my first research questions address design and play:

*[RQ1.1] In what ways do the design strategies of robustness and versatility facilitate playable game experiences?*

*[RQ1.2] In a flexible digital system, what communicative features are important for the negotiation of rule-changing by players?*

Design Idea 1 and 2 will bring to surface two types of tradeoffs. These will comprise my second set of research questions.

- **Tradeoff A:** General game platforms versus specific game instances

*(e.g., Design Idea 1 vs Zynga Poker)*

*[RQ2.1] What tradeoffs can be expected when comparing a manual game system (i.e., a generic playing-card simulator) against a fully-automatic, yet rigid, solution (e.g., Yahoo! Bridge)?*

*[RQ2.2] How can semi-automatic components be added to a robust game system to improve the versatility of a game system?*

- **Tradeoff B:** Robustness strategy interacting with or against Versatility strategy. *(i.e., Design Idea 1 vs Design Idea 2)*

*[RQ2.3] Given that flexible strategies do not necessarily overlap, what tradeoffs can be expected when a system is being designed both to be robust and semi-automatic?*

## 3 Related Literature and My Preliminary Work

### 3.1 Criteria for Flexible Digital Systems

Sometimes, game rules require bending, breaking, and reinvention. For example, a game of poker where actual money is won and lost is very different than a pick-up game of poker for push-ups. Cheating in the former case is tantamount to theft while, in the latter case, a mischievous player might show his cards to another player for the fun of it. His rule-breaking behavior is permitted and even enjoyed if other players recognize the transgression as being in tune with the frivolous context. In another example, an experienced player might ask to look at another player's cards and advise him on the best card to play. By bending the rules a little, the group is able to create a play experience where everyone, the novice included, can play at a desired skill level.

How would a game designer program a digital version of these games that fits these contexts? For casual poker, programmers may want to facilitate "cheating" and bending the rules. When the casual example is desirable, does the software prevent information sharing?

I define a flexible digital game as a game system that allows players (not software designers) to decide on the rules to enforce, who enforces them, and when they are enforced. I propose that games can be judged flexible according to the following criteria:

a. *How much can the rules change?* To be more precise: "Given a set of potential rule-changes, how much of that set can be played within the game system?" The rule-change of permitting players to trade cards with one another is an example where a deck of cards is considered more

flexible than Microsoft Hearts. Microsoft Hearts cannot support this rule-change while the physical card deck supports it.

I emphasize a given set of rule-changes because this criterion can be abstract. The number of possible changes to the rules is effectively infinite. And, yet, there is a point when extreme flexibility is not necessary. Given a little creativity, one can think of a new rule that exposes the rigidity of any medium. For instance, suppose if, every five seconds, the player can rip a card in half and acquire extra points for a clean tear. This rule shows that both mediums do a poor job of “being flexible”: no computer program is this detailed and paper cards cannot recover from the damage. However, in almost all gaming contexts, this rigidity of ‘unrippability’ is completely acceptable. Thus, this first criterion for flexibility is more tractable when properly scoped.

b. *Who can change the rules?* Who has authority over the adoption, interpretation, and enforcement of the rules? A more flexible digital system grants autonomy to its end-users to change the rules that have been embedded in the system.

c. *When can a player change the rules?* Flexibility implies low time-cost for rules to change. Ideally, if players change the rules of a game, the game system does little to nothing to interrupt the flow of the game. Many first-person 3D shooting games are famous for supporting modifications (Nieborg, 2005). The Half-Life 2/Source engine by Valve has been adapted to create new games and variants such as Counter-Strike and Team Fortress. However, these examples are less flexible than a simple deck of cards. Card games played without the computer permit players to tweak the game in the midst of play, a kind of live-tweaking.

### ***3.2 Clarifications and Terminology in this Dissertation***

Before continuing my review of flexibility, here are some clarifications. First, I am not advocating flexibility as a complete positive. The ability to change the rules is not an essential element of game-play, nor is it necessarily desirable. Flexibility may make it easier to cheat, a subversive behavior antithetical to the success of many online gaming communities. Also, creative players can often ‘play’ within the rules of a game despite the rigidity of its medium. Thus my study of flexibility is better characterized as an exploration of digital play rather than as a discovery of the ‘better’ way to design game systems.

Second, my primary interest is in the design of multiplayer games. This is not to say that the research here is inapplicable to single-player experiences, but that the reader should assume that the default scenario that I am describing is one with more than one player engaged in a common play encounter.

Third, the words “flexibility” and “rigidity” in this dissertation are being used in specific ways. “Flexibility” is used here in two ways, as a strategy and as a system property. As a strategy, I mean a design strategy. The idea is that a software designer creates a product and releases it to the public. This means that the design is capable of accommodating unexpected changes to the requirements. My review of related literature in the next section will offer more detail and will highlight two types of sub-strategies: robustness and versatility. As a system property, I mean that a system is or is not flexible. I use this definition to discuss the flexibility of software as an adjective describing the code: something that can be reshaped and will not break. In this dissertation, I am not using flexibility as a description of play style, e.g., “flexible play”.

Regarding “rigidity”, I am using this term as a system property that shows inability to accommodate change. This is the opposite of flexibility. If you rip a card in half, that card will be unable to recover from the stress. If you seek to change the rules of Microsoft Hearts to play with 5 people, it is rigid because this is impossible. In this dissertation, I am not using “rigidity” to describe rules. Game rules are like absolutes in a play session, but they can still be changed, amenable to compromise and violation. Thus, rules can be fluid and I treat them as such in my research approach.

### ***3.3 Flexibility as a Strategy***

Merriam-Webster defines the adjective “flexible” as “capable of being flexed”, “yielding to influence”, and “characterized as a ready capability to adapt to new, different, or changing requirements” (“flexible,” 2011). This definition is useful in portraying the design goal of this dissertation. The object meant to be flexible is the game medium. The new, different, or changing requirements are the changing rules of the game. The term flexibility provides a mental image of a physical medium that can stretch, bend, and reach in many directions without breaking. This picture, alongside the dictionary definition, helps to convey my goal for design. However, this physical metaphor has its ambiguities. Does flexibility imply movement or adjustment of some kind by the flexible object, making dynamism necessary for flexibility? Or, when requirements and rules change and the software needn’t change, is that a flexible property? By reviewing the use of flexibility in the literature, we can arrive at further precision about how this term is being used in my dissertation to build on existing work on flexibility for software systems.

In Saleh et al.'s (2009) multi-disciplinary literature review of flexibility, they explore its use across multiple disciplines. In much of their review, Saleh et al. discuss flexibility as what I would label as a *strategy* for action. For example, a flexible decision is to choose to go to a shopping mall rather than to choose to go to a boutique because this increases the number of shopping options should an appropriate gift be difficult to find. Saleh et al.'s discussion of flexibility touches on decision theory, the managerial sciences, manufacturing, engineering and design science.

Decision theory defines a flexible decision by taking two periods in time, each period with a set of available decision-choices. A choice made in the earlier period affects the number of choices available in the latter period. The choice that provides more available choices in the future is the one that is more flexible (Mandelbaum & Buzacott, 1990).

Managerial sciences are concerned with how flexible an organization itself can be in the face of a dynamic market. For the organization, "flexibility" is a *strategy* that has certain sub-stratagems. Evans (1991) investigates a dozen related terms (adaptability, agility, corrigibility, elasticity, hedging, liquidity, malleability, plasticity, pliability, resilience, robustness, and versatility). He arrives at three senses of the word flexibility: (a) yielding to pressure, (b) capacity for new situations, and (c) susceptibility to modification. Evans' resulting framework has two dimensions, time and intention (See Figure 3.3).

Figure 3.3 Strategic Flexibility relating to a critical moment when flexibility is needed (Evans, 1991)

		<i>Time</i>	
		<i>Before</i>	<i>After (the need for flexibility)</i>
<i>Intention</i>	<i>Offensive</i>	Agility / Versatility	Liquidity / Elasticity
	<i>Defensive</i>	Robustness / Hedging	Corrigibility / Resilience

As an organizational strategy, this framework for flexibility is fitted closely with the problem of achieving market dominance in a fast-moving environment. A flexible organization can adopt a defensive strategy, preparing backups for developments that cost the company resources, and an offensive strategy, positioning its operations to quickly change direction. Evans distinguishes between properties useful before and after an event that demands strategic flexibility.

Nelson & Nelson (1997) continue along this organizational perspective by considering the flexible requirements for technological infrastructure. Their flexibility framework discusses where technology fits in a flexible organization. The two flexibilities that they emphasize are structural flexibility and process flexibility. Respectively, they address these two questions: (a) can we adapt the technology's functions to fit changing processes? (structural flexibility) and (b) can we make changes to the technology by following management processes (process flexibility).

Manufacturing flexibility is equated to the capacity for manufacturing systems to cope with uncertainty and changing environments. Saleh et al.'s review discusses types of flexibility. They list volume flexibility, routing flexibility, expansion flexibility, and product-mix flexibility as

examples of how a manufacturing plant can anticipate changing requirements for demand, for growth, to the manufacturing process, and for product variety. A notable insight is that one flexible strategy (say the capacity to produce more widgets) does not necessarily improve another requirement (such as the capacity to produce different widgets).

In engineering design, flexibility can be treated both as a system property and as a strategy within the design process. Regarding the design process, Chen & Yuan (1999) are concerned that, “early in the product development, the level of performance that will be judged as desirable or acceptable may be uncertain”. They explore probabilistic models that are less strict in their requirements so as to allow promising early designs to survive early evaluations. Chen and Yuan seek to represent design variables for “ranges” of potential solutions rather than “point” solutions to enhance the flexibility of the design process. They describe this approach as one that is consistent with Simon's (1996) design term, “satisficing”. (The contrast between an optimal and a satisficing solution also appears in the literature discussing flexibility as a property. It is an interesting question when applied to leisurely activities. I return to this topic in the sections to come.)

Many of these theories on flexibility favor a quantitative approach, using mathematical formulae to calculate either optimal or “satisficing” values of design parameters. The precision of this approach better fits problem spaces whose key variables can be modeled with ordinal precision. Although card game design is too broad and messy (as a social system) to allow such granular variables, I do rely on a similar vocabulary when I scope my definition of flexibility within a given set of rule-changes (Section 3.1).

In sum, I note four insights from this material.

(1) *Flexibility can be roughly distinguished between a strategy and a system property.*

Due to my interest in flexibility as a property of a game system, I find that this division helps to disentangle the surrounding literature on flexibility. A noticeable difference between strategy and property is that a flexible strategy involves people (i.e., human agency) inside the system. For example, an organization or a manufacturing system's flexibility depends on a mix of policy, reconfigurable sub-systems, and people inside the system who can take advantage of unexpected opportunity. A flexible computer component, on the other hand, does not integrate human agency within its internal functions. This distinction is useful here because it highlights the role of people in flexibility.

This implies that a larger context of flexible *human* behavior will impact how users play with a flexible game system. If users are uninterested in changing any rules in a game, then there is no difference between a flexible system and a rigid one, except that the rigid one may be a more optimal solution.

(2) *Flexible strategies that do not address the same requirements may not overlap, and may even counteract each other.* To employ multiple strategies for flexibility require awareness that one strategy may produce tradeoffs in another, despite both bearing the name "flexible".

(3) *Fitting with Evan's offensive strategy, designers of systems that offer a variety of options can be characterized as taking a versatile strategy.* A versatile system can accommodate multiple use-scenarios and can support them very well. Game systems that offer adaptable and

customizable systems are providing a broad range of “point solutions” that are meant to better optimize the user experience in the face of a variety of unexpected requirements.

(4) *Fitting with Evan’s defensive strategy, systems can offer robustness as another form of system flexibility.* In addition to focusing on how intelligent, adaptive, or customizable a system is, a system can offer some ‘robust-ness’ (to use Evan’s terminology) by providing a simple system that can play any game, even if the solution is not optimal. For example, if Microsoft Hearts allowed players to change the game mode from fully automatic scoring to something that resembles Microsoft Excel, this manual mode, while tedious, would still be playable, capable of accommodating new rules for how to score the game. Thus, quick software readjustment is not the only solution; this perspective is not obvious when the focus of system design is only on customizability.

(5) *Flexibility is tied closely with time-constraints.* From an organizational perspective, the capacity of an organization to take advantage of a fleeting opportunity is measured not only by the idea that redirection is feasible, but that the organization can move in a fashion that is timely.

### **3.4 Flexibility as a Property of Digital Systems**

Regarding the design of a system that can be called flexible, Suh (1998) defines these as systems whose functional requirements are time variant. Saleh, Hastings, & Newman (2003) and Saleh et al. (2009) emphasize that cost-effectiveness of readjustments are a key component in system flexibility:

*“the property of a system that allows it to respond to changes in its initial objectives and requirements—both in terms of capabilities and attributes—occurring after the system has been fielded, i.e., is in operation, in a timely and cost-effective way.”* (Saleh et al., 2003)

Methods for achieving this flexibility include platform-based design (Sangiovanni-Vincentelli, 2002; Simpson, Maier, & Mistree, 2001), component-based design (Crnkovic, Hnich, Jonsson, & Kiziltan, 2002; Lee & Sangiovanni-Vincentelli, 2011), modular-based practices (Tu, Vonderembse, Ragu-Nathan, & Ragu-Nathan, 2004) and, specifically for software applications, one can turn to software modules (Haefliger, Krogh, & Spaeth, 2008), end-user programming (Ko et al., 2011), and software agents (Ciobanu & Juravle, 2011). Also, in conjunction with the notion of a responsive, reconfigurable type of flexibility, a sufficiently general software tool may be robust enough to cover many unpredicted contingencies without resorting to reconfiguration.

There are a variety of approaches for tackling unpredictable requirements. For instance, Dourish (1996) pursues flexibility in CSCW toolkits (Computer-Supported Cooperative Work). Dourish’s stance is that flexibility in CSCW applications relies on the flexibility of the toolkits over which those applications are programmed. Dourish’s approach requires a grasp of what flexibility is at the application-level and at the toolkit-level. Arguing that they can be taken together, he emphasizes two major themes of flexibility: (a) genericity and (b) extensibility:

*“On the one hand, toolkit design strives to maximise the generality or commonality of the toolkit’s component structures, so that they can be used in multiple applications. On the other, it emphasises the flexibility in the ways they can be instantiated and manipulated (so that a wide range of applications can be*

*derived from these components). The flexibility which allows common components to be used in different ways and to different purposes has to be balanced against other criteria such as interoperability, consistency and integration.”(Dourish, 1996, pp. 21–22)*

A useful concept from Dourish is that of the “locus of flexibility”, defined as “the point within the system where flexibility is handled and exploited”. Dourish requires this distinction because his domain of interest crosses from end-users to programmers and from toolkit to application-level.

In summary, within the context of a flexible card game system, the overall picture of flexibility can be described in the following way. The software designer, in this case, myself, is the one that needs to take a strategic approach to flexibility, choosing design maneuvers that will allow the game software to accommodate unpredictable rule-changing behavior by the users.

It should be emphasized that this frames the players’ rule-changing behavior not as a creative or flexible type of behavior. Instead, players may actually be quite in-flexible in their demands.

Seen in this light, our original narrative about the mother and her daughter is a scenario in which the mother is being highly demanding of Yahoo! Cribbage and inflexible in that she doesn’t want to play the game the way that the programmers expect her to. My research question, of course, is to anticipate how the software should bend, not the player.

To allow the software to meet many demands as play progresses, I will investigate two strategies: (1) build a **robust** system that is general enough to accommodate all card games and (2) add **versatility** to that system by leveraging automation and computing power to facilitate a

more optimized game experience. The design work for such a system will be modular and component-based. Furthermore, in this context, the rule-changers are not expected to be expert programmers; the field of End-User Programming has direct relevance in this context.

### **3.4.1 End-user Programming**

In this dissertation, end-user programming (EUP) acts as a source of direction for how to design a system that gives its users the power to reshape it. The model of the ‘end-user programmer’ is a person with two properties. First, he or she is motivated to exercise changes to software that are unanticipated by the original designer. Second, he or she lacks the expertise to dive into the source code of the software and accomplish a modification. The goal of EUP is to overcome this barrier of expertise so that when a user needs to redesign software, he or she can accomplish the task easily and quickly return to his or her original task (Ko et al., 2011; B. Myers, Ko, & Burnett, 2006).

The EUP agenda aligns with the idea of a flexible game medium. In both cases, the user intends to adjust a system of rules; and, often, barriers exist in the design of the software. The differences between end-user programming and flexibility arise only in scope and emphasis. EUP predominantly addresses the user’s ability to manipulate the software with emphasis on overcoming the challenges that seasoned programmers face. Complex digital games offer similar challenges.

Domain-centric projects, such as the Alice programming tool<sup>5</sup>, a programming environment for novices that can create animations and even games, are scoped in such a way that the software and programming-activity take high importance as the objects of study. However, Alice uses games as a learning experience (e.g., Squire, 2007), not primarily as a playful space.

The project, FlexibleRules (Frapolli, Brocco, Malatras, & Hirsbrunner, 2010; Frapolli, 2010), focuses on the capacity to reprogram a digital board game on the fly. FlexibleRules offers a programmatic approach to expand the flexibility of a game platform. Users are provided with programming tools such as a graphics editor, a logic editor, and a code editor. They are then offered the capability to access these tools during an actual game session. Initial user evaluations were conducted where players were assisted by a programmer as they were asked to play and to choose or discuss changes to the programming of the game. Among three activities (a version with no changes, an activity where customizations were offered only at the beginning of play, and an activity where customizations were allowable during play), novice players preferred to have customized rules before a game started and experienced players preferred the opportunity to make changes during play.

Both Alice and FlexibleRules demonstrate value in their approaches to overcoming the hurdles that complex game platforms offer to motivated gamers. FlexibleRules in particular shares the same motivation as this dissertation in how the project is similarly inspired by the flexibility of analog games. The flexible design strategy is differently focused than mine in two key ways.

First, they concentrate on game rules that are embodied in the software and do not address game

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<sup>5</sup> <http://www.alice.org>

rules that are purely social in how they are enacted and enforced. Second, they expect players to engage in the flexibility of the system by using an extended Lisp language that is domain-specific for board games. My claim is that social rules and programmed rules should be separated in considering flexibility. As such, the contribution of these programmatic strategies for flexibility and my contributions are complementary, covering different domains.

### **3.4.2 Expecting Tradeoffs, or Are Flexible Digital Systems inherently sub-optimal?**

I close this section on flexible properties by returning to a point made in Saleh et al. (2009) and Chen & Yuan (1999) suggesting that the cost of a flexible design decision is to sacrifice a single optimal solution for a range of satisficing solutions (Herbert Simon's terminology (Simon, 1996) at work here). This highlights the importance of uncovering the trade-offs inherent in design a flexible game system.

Some immediate trade-offs in interaction costs arise when speculating about how a generalized card simulator would work in contrast to Microsoft Hearts (who shuffles? Who deals? How is complicated scoring managed?). But some carefulness is required before equivocating existing "point solutions" (e.g., Microsoft Hearts, Yahoo! Cribbage) with optimal ones. Playfulness and leisure do not have the same success measures as work-oriented activities. For example, the chore of recording everyone's score at the end of a game does not necessarily constitute tedious activity. This question and others about the peculiarity of game play and flexibility will be introduced in the next sections.

### **3.5 Flexibility and Game Studies**

Game Studies, as a discipline, targets games and play as a primary subject of interest. Due to this focus, the field is multi-disciplinary. Three branches, in particular, are fairly active. These branches originate in the social sciences, the humanities, and engineering. The social sciences examine the effects of games on individuals and societies, e.g., (Go et al., 2012; Hughes, 1983; Huizinga, J., 1938)). The humanities wrestle with the meanings in and of games, asking questions such as ‘what is play?’ or ‘what are game rules?’, e.g., (D. Myers, 2005; Salen & Zimmerman, 2004; Suits, 1978). Engineering channels its sub-disciplinary interests through videogames as technological artifacts. For example, the simulated graphics in a videogame provide challenges for the computer graphics; intelligent behavior by computer agents are a testing ground for artificial intelligence; and large-scale networked games demand innovation in networking solutions.

The question raised in my literature review for flexibility as a strategy is a demand for a better understanding of rule-changing behavior by players. In games studies, the suggestion is that rule-changing happens for a number of practical reasons (inclusion/exclusion, fairness, and to keep the game moving along) and that authority and power dynamics play a role in their vetting and adoption (Freie, 1999; Hughes, 1983). Hughes (1983) draws on a multi-year observation of children playing foursquare to show how games “display much more flexibility than might be suggested by their [formal] rules” (Hughes, 1983, p. 506). She reports on the contest between the boys and the girls in the playground as they dispute rules that are intended to favor the girls (“nice” rules). Hughes reminds researchers that game rules are not simplistic or monolithic. Instead, as social rules, they are subject to constant negotiation and reinterpretation. Freie (1999) reports on her five-month fieldwork watching children play at an elementary school. Her

findings expose children's leverage of the "plasticity" of rules to make the game fairer, to include/exclude individuals, and to keep the game moving along. Notably, both studies appear to circle around the role of power and rule-changing. The Foursquare report describes a struggle between inclusion and exclusion. Freie identifies the rule-changers as "particularly skilled or popular".

The characterization of the rules as a social agreement is addressed also by the philosopher Bernard Suits (1978). Suits coins the term 'lusory attitude' as the state in which a player willingly submits to the arbitrary restrictions and rules of a game. A person entering a foot race is agreeing to forgo the more efficient path of cutting across the center of a circular field. For a game to occur at all, the lusory attitude is an essential ingredient, an ingredient that is positioned very deeply in the midst of a social context. Rule negotiation, especially during a game, is the establishment or revision of aspects of that agreement. It requires communication, negotiation, and acceptance. The complexity and nuance of rule negotiation is not unique to the whole picture of gameplay. Rather, it is just another part of the complexity and nuance of gaming in general. Influential in interpreting a variety of digital games, T. L. Taylor's notion of assemblage (Taylor, 2009) emphasizes that games are a multi-faceted interrelation between technological artifacts, game experience, and sociality. Notably, she illustrates her point with a description of players who use an in-game mod for World of Warcraft. This mod assists the players as they play and, in doing so, shapes the social play style of its adopters. When the mod fails to do its automatic job of warning players and directing players, players step in and act as 'mods' themselves, giving out instructions and updates as if they were the properly functioning mod. Thus emerges a picture of rule-negotiation that is a social agreement embedded in an 'assemblage' that includes nuanced interaction between manual effort and computer automation. This connection to automation leads

to the next question for game studies and flexibility: what is the role of the *medium*'s flexibility in this complex negotiation?

Customizability is the capacity to change the rules of a game as encoded in the software. A common perspective of the games industry is that customizability is a value-add (Pinelle, Wong, & Stach, 2008). Game reviewers see it as a way to increase replayability and to adjust the settings of a game to fit the players' skill level. Design ideas for customizability have branches of thought that have been explored in research and in practice. It is not new for digital games to have a rich history of configuration and modification. Text-based Multi-User Dungeons (MUDs) permit players to program within the system (Turkle, 1995). Creative game-players with expertise in software-engineering produce modifications of games that drastically change the interface and/or behavior of a game system (Kücklich, 2005; Sotamaa, 2010).

As I have already alluded to with the lusory attitude and the notion of assemblage, I claim that what is missing in these discussions on customizability is sensitivity to the practice of tailoring, customization, or tweaking during game-play. Design choices for customizability in games appears to be more focused on practices outside of game-play: game modifications are programming activities outside of game-play and video game configuration/options screens require at least a pause in game-play if not a complete restart of the game. Even the FlexibleRules project which advocates live flexibility requires a modal change, interrupting gameplay to accomplish changes to the code. In non-digital games, however, in the *midst* of game-play, the practice of tweaking or adjusting a game is common-place. Such "live-tweaking" in digital games is an under-explored phenomenon both in design and in theory. It will be one of my design goals.

Second, drawing again on the reminder that game-play also encompasses social rules: the limit of current discussion on “customizability” is that it focuses interest on rule-changes that are tightly coupled with software changes. My definition of flexibility circumscribes a wider interest: asking not only how a medium can change to accommodate rule-changes, but also asking how the medium, as is, is robust enough to support rule-changes. One needn’t a new glove to switch from a game of baseball to a game of catch.

Finally, the literature from game studies suggests that the negotiations in a game are influenced by social nuances such as power, group dynamics, and personality.

### **3.6 Technology for Leisure**

As computing technology begins to seep into domestic life, Gaver (2002) asks a shaping question of design outside of the workplace. He argues that we have carried over an expectation of productivity into technology for the home. Putting that expectation aside, Gaver asks, “What if computing helped us pursue our lives, not just our work?”

Employing Huizinga’s term (1938), *Homo Ludens*, translated “man the player”, Gaver challenges researchers to consider the possibilities of designing to support a different purpose for living: playfulness. For researching technology in the home, this expands the agenda beyond problem-solving.

In support of playfulness, Gaver emphasizes the importance of making technology appropriable:

...designing for Homo Ludens means allowing room for people to appropriate technologies. Playing involves pursuing one’s inner narratives in safe situations, through perceptual projection or, ideally, action. If computational devices channel

people's activities and perceptions too closely, then people have to live out somebody else's story, not their own. (Gaver, 2002, p. 4)

Computer-supported game-systems constitute a domain of interest that crosses out of the workplace and into the home and other leisurely contexts. Taking Gaver's lead, I believe it worthwhile to adopt playfulness as a worthwhile goal of designing for everyday living.

"Flexibility" intertwines very neatly with the quote above.

### **3.7 CSCW: Collaborative Systems or The Work of Play**

Computer-Supported Cooperative Work (CSCW), as explained by Schmidt and Bannon (1992), is "*an endeavor to understand the nature and requirements of cooperative work with the objective of designing computer-based technologies for cooperative work arrangements.*" Three emphases for CSCW are, first, a commitment to cooperative work, second, a focus on computer-based solutions, and, third, an emphasis on finding design-oriented solutions. All of these apply to game studies when examined in the context of digital games for multiple players. The digital medium provides computer-support for play. The context is social. The cooperative-work of play actually gives rise to an interesting dynamic between the idea of 'work' and the idea of 'play'.

In elevating the principle of play, it is not necessary to abandon wholesale the idea of work. To paint play as the opposite of work is a bit of an illusion. This division hinges on what counts as work. Is effort required? A profitable result? In play, there is effort expended to set-up a game of cards, to shuffle, to rearrange the rules, and even playing itself. An athlete works hard to win a game. Therefore, although I am interested in what is generally a slippery concept of playfulness and fun, on very tractable level, I am interested in the functions, the effort, and the products of those efforts as game players 'work' to 'play'.

In their ethnography of a mobile SMS game event, Crabtree et al. (2004) temper Gaver's assertion by finding, in play, aspects of work. They point out a kind of behind-the-scenes facilitation that they label "orchestration work". The research team observed how the game staff customized game messages for the players by tailoring messages to the recipients. Also, they observed the management and tracking of narrative production. Crabtree et al. recognize the work to make play happen. It is social (staff relied on awareness and coordination practices). And, customization requires it (Crabtree et al. go as far as to say that "orchestration work is identical to the work involved in customization").

Crabtree et al.'s ethnography focuses on the work practices of the staff rather than game-players. Is similar work accomplished by the players themselves? Yee (2006) challenges us to see the blurriness in the distinction of work and play, recognizing the uncanny similarity between the daily grind of real life and the obligations of grinding, occupations, or quests in massively multiplayer roleplaying games such as Star Wars Galaxies. Play can be tedious.

In contrast, Xu et al. (2011) show how work can be fun. They report an empirical study of recorded video from board game play sessions. They focus especially on the social activity that they label *chores*, "interactions arising from the bookkeeping activities required to maintain and update game state". Xu et al. claim:

When designing a digital game, it is natural to think about leveraging computing power to remove these chores. However, we found rich social interactions arising from such chores. On the surface level, these social interactions were enabled because chores slowed the pace of the game and created time that players wanted to fill with other activities. But, deeper analysis of players' behaviors surrounding

the chores showed evidence of enhanced physical co-presence with the group and an increased awareness of other's actions. (Xu et al., 2011, pp. 7–8)

Given the importance of coordination or chore work in gameplay, especially in situations of customization, I believe that it is important for the designer to anticipate the nature of the work when the flexibility of multiplayer systems is put to use. Starting with Xu et al.'s findings, I highlight a number of relevant concepts in the CSCW literature:

*Manual chores can be fun, supporting social performances; instead of replacing them with automation, digital chores might be augmented in a way that allows the players to perform for each other* –An operator of a computing device is also a performer. Dalsgaard et al. (2008) remind us that a user is a simultaneous operator, performer, and spectator. Reeves et al (2005) offer a taxonomy for understanding how device operation is a performance, a combination of manipulations and effects.

*Roles in Customization* – Wendy Mackay (1990) finds that customization can be driven by a cooperative social context. In organizational settings, she discovered that not everyone created customizations scripts despite their need for them and their use of them. Rather, a small percentage of experts programmed the scripts and a network of sharers passed them around. A key role in this social setting was the translator. This person sought to take the customizations and help match them to the needs of the rest of the organization. Mackay's contribution refocuses our eyes on flexibility from an individualistic to a social perspective. It will be important to look for the roles that game players adopt when game rules are changed. The social setting for this dissertation is different in that it is a focus on small-group interaction, but the lesson that can be applied is a caution against expecting everyone in the group to behavior

similarly with regards to customization work and to anticipate ways in which the group members help one another customize. I expect this to play a sensitizing part in the analysis of Card Board's user studies.

*Device as a ground for communication and collaboration.* Of interest to CSCW is the exploration of how computing technology acts as a medium of collaboration and communications. In one way, this is exemplified in inquiries such as the Media Space work (Bly, Harrison, & Irwin, 1993). These studies regard computing media as a new channel over which communication is practiced, sometimes as a supplement to other channels (i.e., telephone, email, face-to-face) and sometimes standalone. In line with this, I am interested in CSCW work that regards computing media as a collaborative tool. For example, paper strips provide a medium for complex cooperative behavior by air traffic controllers (MacKay, 1999). Games systems facilitate communication; and, the game play itself serves as a communicative act (McEwan et al., 2012).

To explore how game-systems act as platforms for coordination, I have chosen to apply Clark and Brennan's (1991) theory of Grounding in Communications to my work. It acts as the foundation for evaluating the role of the medium in communications and, with minimal adaptation, promises a design-oriented approach to support coordination and play.

### **3.8 My Preliminary Work**

This section explains how my prior research informs the methods and thinking for this dissertation. In it, I summarize work from Coardial, a flexible card game platform built for a mobile device (Cheung & al., 2013), a paper on rule-changing behavior in analog and digital games (Cheung & Huang, 2012) and mention other related work including, “Consciousness in Gameplay”(Cheung, 2011) and “ ‘Take That!’: Evaluating Game Systems as Communicative Media” (Cheung, 2012).

### **3.9 Coardial**



*Figure 3.9.1 Turn-tracking Device*



*Figure 3.9.2 Cardholder and Information App*

Coardial is a flexible card game system based on similar design goals as this project with the additional goal for deployment on mobile devices with sensing technology to provide tangible play experiences for in-person face-to-face game experiences.

This project is built on Near-Field Communication (NFC) technology<sup>6</sup> to tag playing cards with unique identifiers that allow a mobile device to keep track of game resources. Data input is accomplished by physically tapping the phone's NFC chip to the chip on the playing card. The technical aspects for this project was informed by Sarmenta (2011), which demonstrated NFC game functionality and interaction techniques with three example games.

The design goals of this project were to produce something flexible, allowed players to socially-negotiate the rules, and remained tangible and mobile. We developed an architecture for connected game components that passes messages to each other via a blackboard (Silva, Garcia, & Lucena, 2003).

The two figures in the section demonstrate two components within the game toolset: A turn tracker (Figure 3.9.1) that is aware of whose turn it is and understands enough game rules to facilitate gameplay and, secondly, a personal information dock (Figure 3.9.2) that players can use as a digital rulebook and scorekeeper.

Over the course of the design, implementation, and evaluation, we came to rely on a number of design insights. The source of these insights emerged during the process of design, from

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<sup>6</sup> NFC is a subset of the RFID (Radio-Frequency identification) specification. It allows devices to read and write to chips but restricts the physical distance between sensor and chip to a very small distance no more than 20cm. In practice, this sensing distance is even shorter.

observations during user testing, and from feedback in evaluative sessions. Here are a few that relate to this dissertation.

1. **A costly interaction activity such as scanning a playing card with a phone can be broken down into the following equation we called “Return on Investment”:**

Interaction Costs → Augmentation

Players wanted to know that the cost of doing a scan was worth their effort. Conceptually, this allowed us to separate interaction costs from augmentation to explore how to make the interaction less tedious and brainstorm valuable augmentations for using a mobile device while playing a game. While augmentation is not a priority in this dissertation, the importance of considering the interaction costs in my design work is further supported by this finding.

2. **Player expectations for digital intelligence, or, “It should be right”.** Players focused a lot on whether or not the device knew what cards were in whose hands and often expected the device to be smart enough to keep track of physical cards and enforce game rules. This finding is also present in Pape’s work (2012) with automation and digital board games via player frustration with incorrectly programmed rules.
3. **Players did not want to be trapped by a system without an undo function.** This might have been due to a number of factors. First, players are used to a style of card/board-gaming where provisional actions can be tried out and rolled back. Second, users may be accustomed to undo functionality in many software applications and can easily envision what that functionality would look like in a digital game system and expect it.

4. **Ask, “what is the attentive focus of this moment?”** The moment-to-moment situation context proved to be something that changes throughout the course of a game. Consequently, the requirements for interaction design change as well. For example, during a scoring at the end of a game is a dramatic activity where everyone pays attention to the scorekeeper (a small device screen in this situation is a limitation). Yet when players are arranging the cards in their hands, the attentive focus is individualized and the personal size of display screens and buttons no longer needs to service a larger area.

These lessons can be applied fairly directly to the design of Card Board in this dissertation. In addition to applying the above bullet-points directly to the design of the system, they sensitize me to the importance of interaction costs. Additionally, player expectation for computing platforms may run contrary to a manual “dumb” mode. For user study in this dissertation, participant training will be important to familiarize users with the general functionality of robust systems so that users can accurately assess how appropriate the system is for their expectations.

### ***3.10 Remix and Play: Lessons from Rule Variants in Texas Hold'em and Halo 2***

In my own examination of rule-changing in Texas Hold'em and Halo 2 (Cheung & Huang, 2012) we sought to explore rule-changing behavior.

Starting with the understanding that players can change the rules of a multi-person game to experience a different gameplay mechanic, add thematic color, or fine-tune its balance, we used a grounded approach to analyze 62 variants for Texas Hold'em, a popular card game, and a follow-up case-study of 91 variants of Halo 2, a popular video game. We studied their development and examined whether lessons from Texas Hold'em applied to a constrained

system such as Halo 2. We discovered video gamers' reliance on 'honor rules', rules dependent on the cooperative spirit of its players.

We developed a theory of 'necessity' in rule adoption, showing players' sensitivity to the impact of one change on the whole game. Our analysis noted that rule-changes were discussed within the context of a desire or a need. Examples include: game balance, thematic variation (e.g., "Baseball"), or fun. Game rules were changed to meet those needs. The discussion around new rules or proposed new rules saw them as (a) satisfying, (b) optional, or (c) spoiling. Given a need, satisfying rules were described as fulfillments of that need. Optional rules had no direct impact on the need (thus rule-changers spoke about them as optional). Spoiling rules were commonly suggested rules that were so incompatible with the game that rule-changers went out of their way to identify them as bad rules.

In solving game-design problems, adjustments drawn from a set of 'canned' rule changes address common problems with familiar solutions. An example of a 'canned' solution in Halo 2 is a set of commonly shared instructions on how to start a custom game where all players become weaponless. There is no default setting for this, so players are instructed to follow an esoteric recipe of charging up a gun, picking up a grenade, and moving backwards (this triggered an exploit in the software that resulted with no weapons in hand). This is a solution to a problem (how to drop all weapons). It is 'canned' in that it was a common solution that the community of Halo 2 players was aware of and shared with one another.

This finding is relevant to the evaluation of the flexibility of a game system because the inefficiency of the 'no weapon' recipe exposes (1) how difficult it is to do remove weapons and (2) how much the players are willing to go through hoops to have no weapons. Framed within

my first criteria of flexibility (what rules can be changed), if we observe the formulation of canned solutions over multiple play sessions of a game system, we are discovering both what the players want to do and exposing the rigid edges of the system in how difficult it is to achieve that action.

### **3.11 Other Related Work**

“Consciousness in Gameplay” (Cheung, 2011) is a workshop position paper about gameplay dimensions for understanding action in games. It is more fully introduced and built upon in Chapter 4.4. “Take that!”: Evaluating Game Systems as Communicative Media (Cheung, 2012) introduces a method of evaluating the communicative dimensions of a game by using the theory of grounding in communications (Clark & Brennan, 1991). This material is introduced in Chapter 4.3. Card Board, the software developed for this dissertation project, placed as one of three finalists in the Student Game Design Competition of CHI 2013 under the category of Innovative Game Design (Cheung, 2013).

## **4 Design Investigation**

### **4.1 Introduction**

This section begins my investigation of the flexible design space through the effort of designing a flexible card game system. According to the motivations that I have laid out, I will engage in the act of designing a flexible system, to be named Card Board. I will use this process as a way to explore relevant design dimensions. This design knowledge can then be further evaluated in the future by putting Card Board in game situations with real players. So, Card Board’s design is documented here not only as the introduction of a flexible card game system and an evaluative tool, but the design process itself investigates the design knowledge that supports flexibility.

## 4.2 Goals

My three criteria for flexibility lead to three goals.

*Flexible criteria #1: How much can the rules change?*

The game system should be capable of expressing a significant subset of card game rules. To keep the project feasible, a limited subset of card games will be chosen as a design goal. Certain uses of card decks will be bypassed such as sleight-of-hand in magic tricks. Parlett's book of card games (Parlett, 2008) categorizes card games into eight different types (trick-taking, card-taking, adding-up, shedding, ordering, vying, and banking). These types are based on the main goal of the game. Using this as a guide, I have chosen a cross-section of card games by selecting one game of each type (two for the trick-taking type: one complex and one simpler, Bridge and Hearts). Presumably, the diversity of games will allow players to draw on familiar mechanisms when revising rules. This cross-section will also provide markers for understanding how to transfer findings from the card game domain to other domains, such as board games.

1. Bridge (Trick-taking game)
2. Hearts (Trick-taking game)
3. Memory (Card-taking game)
4. Cribbage (Adding-up game)
5. Crazy Eights (Shedding game)
6. Rummy (Collecting game)
7. Solitaire (Ordering game)
8. Poker (Vying game)
9. Blackjack (Banking game)

*Flexible criteria #2: Who can change the rules?*

Goal: Every player. This invites questions about authority within the social group which I leave open for now; the effects of which will be touched on in the user study. Importantly, the players should have sufficient authority to tailor the card game to their needs instead of being heavily restricted by the software or the intentions of the programmers.

*Flexible criteria #3: When can a player change the rules?*

Goal: Before and during gameplay. “Live-tweaking” as a feature promises to elevate the flexibility of a system.

What follows is a discussion of two sets of design dimensions and their role in designing for flexibility. The applicable dimensions of design are labeled ‘gameplay’ and ‘communication’. My work is informed by conceptual review and preliminary design efforts in creating Card Board, the flexible card game system.

The ostensible reasons for choosing these dimensions are that a game medium is the basic context of play (*dimensions of gameplay*) and a game is a place for communication where players negotiate a common ground about accepted rules (*dimensions of communication*).

### **4.3 Communicative Dimensions**

The design of the software favors social rather than technological means for rule adoption, adjustment, and enforcement. In social settings similar to traditional, analog, card games, this shift in power is a familiar situation. Players sitting around a table with playing cards have familiar social norms about negotiating rules.

However, such confidence about orderly social conduct is weaker when game interactions occur over distance. Online games bring distanced people together to play games, but the interactions are often highly regulated, often done so for good reason. Games that depend on resource acquisition (poker, for example) must guard heavily against cheating behavior (Wood & Griffiths, 2008). Online games can be spoiled by strangers whose main goal is to antagonize the group, e.g., “griefers” (Foo & Koivisto, 2004; Giles, 2007).

Yet, successfully negotiated game sessions are reasonable to expect. The relationship between success, flexibility, and the medium of play is a question that will inform my research question 1.2 (*What communicative features are helpful for the negotiation of rule-changing by players?*)

Successfully played game sessions require players to find common ground about accepted rules and accepted interpretations. The role of a medium in achieving communicative common ground is addressed by Clark and Brennan’s (1991) theory on “Grounding” in communications. They offer eight qualities of communicative media that will act as a guide for choosing and designing the communicative aspects of Card Board and for interpreting the role of the medium as players seek common ground, both in in-person and online contexts.

Below is Clark and Brennan’s list of ‘constraints’ with some adjustments (in parentheses and bolded).

1. **Copresence**: A and B share the same physical environment. In face-to-face conversation, the participants are usually in the same surroundings and can readily see and hear (**and experience in person**) what each other is doing and looking at. In other media there is no such possibility.

2. **Visibility:** A and B (**and/or their surroundings**) are visible to each other. In face-to-face conversation, the participants can see each other, and in other media they cannot. They may also be able to see each other, as in video teleconferencing, without being able to see what each other is doing or looking at.

3. **Audibility:** A and B communicate by speaking (**or sharing audio of any kind**). Face to face, on the telephone, and with some kinds of teleconferencing, participants can hear each other and take note of timing and intonation. In other media they cannot. An answering machine preserves intonation, but only some aspects of utterance timing.

4. **Cotemporality:** B receives at roughly the same time as A produces. In most conversations, an utterance is produced just about when it is received and understood, without delay. In media such as letters and electronic mail, this is not the case.

5. **Simultaneity:** A and B can send and receive at once and simultaneously. Sometimes messages can be conveyed and received by both parties at once, as when a hearer smiles during a speaker's utterance. Simultaneous utterances are also allowed, for example, in the keyboard teleconferencing program called talk, where what both parties type appears letter by letter in two distinct halves of the screen. Other media are cotemporal but not simultaneous, such as the kind of keyboard teleconferencing that transmits characters only after the typist hits a carriage return.

6. **Sequentiality:** A's and B's turns cannot get out of sequence. In face to face conversation, turns ordinarily form a sequence that does not include intervening turns from different conversations with other people. With email, answering machines, and letters, a message and its

reply may be separated by any number of irrelevant messages or activities; interruptions do not have the same force.

7. **Reviewability:** B can review A's messages. Speech fades quickly, but in media such as email, letters, and recorded messages, an utterance stays behind as an artifact that can be reviewed later by either of the partners-or even by a third party. In keyboard teleconferencing, the last few utterances stay visible on the screen for awhile.

8. **Revisability:** A can revise messages for B. Some media, such as letters and email, allow a participant to revise an utterance privately before sending it to a partner. In face-to-face and telephone conversations most self-repairs must be done publicly. Some kinds of keyboard teleconferencing fall in between; what a person types appears on the partner's screen only after every carriage return, rather than letter by letter.

#### ***4.4 Gameplay Dimensions and Design 0, 1, and 2***

From my preliminary work in adapting existing theory on the human experience to game design, I present three gameplay dimensions relevant toward the design of flexible card games. An early version of these dimensions was presented at the CHI 2011 Workshop on "Gamification" (Cheung, 2011). They are derived from my reading of Giddens' explanation of human consciousness and action (Giddens, 1984), closely aligned with HCI terminology for ready-to-hand and present-at-hand (Winograd & Flores, 1987), and tied in with the psychological theory of flow (Csikszentmihályi, 1991).

### *Dimension 1: Gameplay Presence*

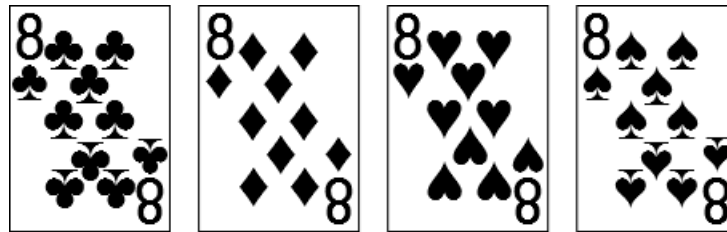
The Gameplay Presence of an object describes how its properties portray relevant information for players to perceive and mentally grasp as they play a game. Note that what ought to be considered relevant is a subjective question. I will return to this issue, but in short, “relevance” can be dictated by the preferences of the game designer or from personal goals of the player. An introduction of “presence” follows.

This term and the next (Gameplay Readiness) are informed by similar terms in interaction design, “present-at-hand” and “ready-to-hand” that describe human consciousness with regards to the tools that they use (Winograd & Flores, 1987).

These terms can be illustrated by an example of a person using a hammer as a tool. In the midst of hammering, the hammer moves away from the forefront of the person’s consciousness into a practical, unproblematic background. He focuses not the hammer’s properties, but on the task. Suppose the hammer breaks during the task. The hammer itself becomes a problem to solve. If the person takes the time to inspect the broken hammer, this changes the attentive focus. The hammer moves from “ready” to “present”, as an object to be inspected. I have taken these terms, “ready” and “present”, and considered them within the narrower scope of gameplay.

To scope this term within gameplay, I consider the game to be won as the problem to be solved. Within the purview of the player, various properties of the game pieces (such as cards, chips, or tokens) surface as critical elements of the problem. In so much as they can be perceived as a puzzle-piece of the game to be mentally grasped and subject to attention, these properties of the game pieces are “present-at-hand”.

On playing cards, the printed symbols have *perceptive properties*. Suppose a group of players tried to play a game of cards where the cards were all printed in black, including the hearts and the diamonds which are traditionally printed in red. So, instead of a black and red deck, one might call this a “Black and Black” deck (Figure 4.4).



*Figure 4.4 A “Black and Black” deck, black symbols on all playing cards.*

It is possible to play all the same games with such a deck as with a black and red deck, but players will be prone to make mistakes. Thus, it can be said that a “Black and Black” deck’s visual properties interfere with “gameplay presence”.

But, what if players find such a troublesome deck amusing to play with? This is where the subjectivity of “relevance” is important to consider. If players deliberately choose to play with a “Black and Black” deck, they want the challenge to be a part of the game. Similarly, skilled players are often said to be playing at a different level than novice players. For a player to become skilled is for him or her to be able to accomplish actions in a game with ease. In essence, they have subsumed certain actions into the practical, unproblematic space of action. This corresponds with Csíkszentmihályi’s description of skill and its role in “flow” (Csíkszentmihályi, 1991), a concept that has compatible phenomenological roots. Thus, the subjective perspective of the player (or at least the one that game designers are aiming for) should be taken into account in considering the gameplay presence or the gameplay readiness of game objects.

### *Dimension 2: Gameplay Readiness*

Gameplay Readiness describes how unproblematically a game object fits into a player's actions. If a game must be considered halted because there is something impeding a player's capacity to play a game, then something is interfering with gameplay readiness. As an example, if a deck of playing cards are too weathered to be easily shuffled, then they can be considered to have poor gameplay readiness.

Like the term before, I employ readiness specifically within the scope of gameplay and I emphasize that readiness depends on what game the players decide to play. If the rules of a game come with the expectation that the cards are too weathered to shuffle (e.g., "Give everyone an old deck of cards. The first person to shuffle the deck wins."), then even a beat up deck of cards can be considered gameplay ready.

### *Dimension 3: Gameplay Adversity*

The adversity of a game environment is the degree to which its material aspects make the game more or less difficult to the players to win. A cross-country racetrack in the Sahara is considerably more adverse than one along the Côte d'Azur due to climatic differences.

Depending on the interest of the designer, adversity can be sub-categorized by different types of resource costs such as time, energy, reflexes, odds, and more.

To make a game of building a house of cards is to play directly with the adversity of the plastic-coated rectangles. Players pit themselves against the slippery cards to build something that is difficult to accomplish.

Adversity speaks to an anticipated difficulty. The appropriate location of difficulty is a design goal for a fluid and engaging experience (Csikszentmihályi, 1991). A medium's features can contribute directly and indirectly to the experience of adversity. This concept is closely tied to the goal of the game.

### *Game Mechanics as Context for Dimensions*

In addition to this conceptual set of design dimensions, I recommend using them in conjunction with a set of typical activities in which those dimensions apply<sup>7</sup>. For example, in a game of cards, specific activities include shuffling, dealing, playing, turn-taking, and scoring. To make this list more general, one can seek broad categories such as set-up, play, and scoring, but I would like to start with a different strategy for contextualizing these dimensions. I would like to start with “game mechanics”.

Game mechanics are part of the general game design vocabulary for describing a mechanism or process that propels the game forward. Schell (2008)'s chapter on game mechanics introduces them as “the interactions and relationships that remain when all the aesthetics, technology, and story are stripped away.” A game mechanic can be abstract, for example, “Rubber-banding” is a mechanism in a racing game where AI racecars (“Artificially Intelligent” racecars) slow down to give a lagging player a sense of competition. The AI racecars “rubber-bands” around the player (Hunicke, 2005). This general mechanism can apply beyond racing games to a variety of media

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<sup>7</sup> My reason for having a set of activities alongside a set of dimensions is because I am modeling my dimensions for design after Green's Cognitive Dimensions of Notation (Green, 1989) which also pairs a set of activities with a set of dimensions. This allows the dimensions to be useful early in the design process, much in the same way that I am applying them early in the design of Card Board.

and addresses a basic sense of competition and progress. Other mechanics can be less broad. For example, one can discuss a peculiar mechanism for one particular game. 6 Nimmt!, a German card game, instructs all players to place their cards at the same time, sort everyone's cards in rank order, and determine the turn order by the result. This mechanism is quite unusual and likely to be found in very few games. Other, more general mechanics in card games are how cards allow players to hide information from one another. Or, cards permit the expression of ownership of resources ("these are my cards.")

Mechanics often involve a tight coupling of rules and implementation. As a result, game mechanics are deeply-linked with rule-changing. When an opportunity arises to disrupt the ongoing order of a game with an exception or a new rule, the game mechanism is likely to be the most rigid part of a digital game. If the programmed mechanism cannot keep up, then the game 'breaks'.

If Microsoft Hearts was redesigned to support a range of Hearts-variants by allowing players to self-regulate: to permit or ban illegal moves, a host of new design implications must now be addressed: Will this affect other features that required only legal moves? How can scores now be calculated if a move is ambiguous?

Mechanistic design decisions promise to be the most disruptive and, therefore, are a good starting point for my exploratory design. Physical cards feature a short list of common mechanisms. Playing cards embody a mechanism for hiding and sharing resources.

Indistinguishable on one side and specially marked on the other, playing cards provide a base for complex game mechanisms about known and unknown resources in a game. Emerging from this

basic property are more abstract mechanisms such as bluffing, betting, shuffling/dealing, drawing, and more.

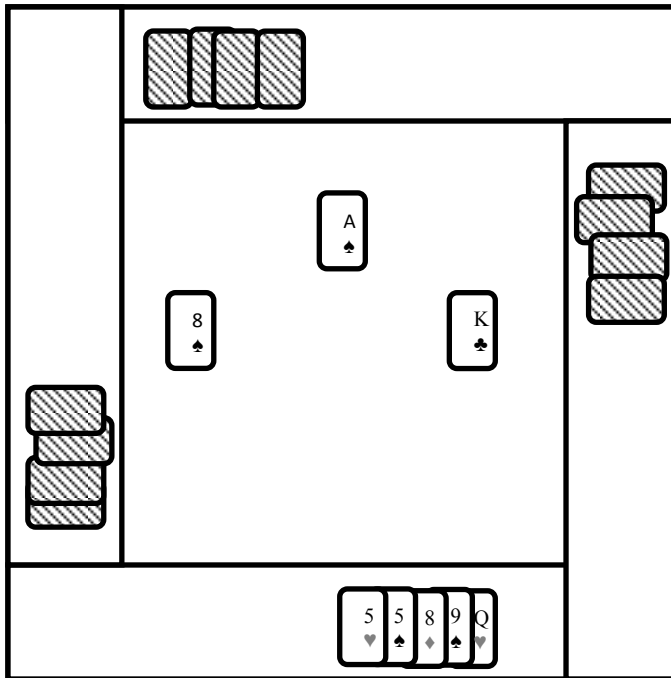
With this commonality across card games, I can produce a very simple design concept for flexibility: Implement a system that allows players to own cards and to position them on a table, face up or down. This is enough to permit many card games to be played and for the players to decide to change the rules when they want to.

To explain this design move using the literature on flexibility in Chapter 3.3 (

Flexibility as a Strategy), I am starting with a general design that is “robust” enough to accommodate almost any change in player requirements for how to play a game of cards. The trouble with this solution, which will be explained shortly, is that it is not optimal.

#### **4.4.1 Design Idea 0**

*Design Idea 0.* Imagine a minimal platform that allows players to own cards or arrange them on a common table. This is a basic simulation of an actual card deck whose mechanistic qualities are bare. To consider a very basic case, I have only retained functionality to make a game possible, rather than easy to play. An assisting feature is shuffling. If players had to, they could drag individual cards around until the deck is shuffled. For this design exercise I have left out an automatic shuffler and other potentially useful assistants.



*Figure 4.4.1 Design Idea 0. A minimal platform that allows players to own cards or arrange them on a common table, but lacking in automatic assists.*

*Design Idea 0*, a system without automatic shuffling, dealing, and few restrictions barely meets my three criteria for flexible play: Any game is possible; The users get to decide how to play; Rule-changing can happen instantaneously. However, it is tedious to play. The amount of effort to shuffle cards would severely disrupt the dimension of gameplay readiness.

This conceptual design provides us with a robust baseline from which we can begin to optimize. To offer balance between gameplay presence and gameplay readiness, we can add automation features to allow common card game actions, this is *Design Idea 1*.

#### **4.4.2 Design Idea 1**

*Design Idea 1* is a low-automation optimization of its predecessor. The distinguishing design ethos of this iteration is robustness. The robustness of this design is in how much a traditional

card deck can be simulated because a simple simulation should be able to handle almost any rule-change. Priority will be paid to implementing mechanisms (shuffling, sorting, dealing) that are common across a high number of card games. The vision is to improve gameplay readiness such that it can match a normal physical card deck and to reduce the interaction costs.

The type of tradeoff that Design Idea 0 and 1 surfaces is the gap between a satisficing range of possibility and a more optimal point solution.

#### **4.4.3 Design Idea 2**

*Design Idea 2* is to further augment the system by (a) introducing automated components so that end-users can optimize their experience of a specific game-type (poker). (b) This is to be accomplished while still preserving as much of the robustness of the previous design. The flexible strategy that is being explored with this design is versatility. In a deployment context, a system designer would offer a library of automatic components for the players to choose from. These are prepackaged point solutions that improve the optimality of the system for different requirements. The larger this library is, the greater the versatility.

There is non-trivial design work to bring Design Idea 2 into realization without sacrificing the three criteria for flexible play that have been promoted by the robust design. To maintain reasonable scope in this project, I only focussed on the poker genre: a “Dealer” that can keep track of whose turn it is and can recognize relevant patterns of cards depending on what game is being played. (e.g., in a poker game, straights, flushes, full houses.) More specific details about Dealer appear later in this dissertation.

#### **4.4.4 Summary**

At this point, the conceptual groundwork has been laid and some general requirements have been outlined. Drawing on my criteria for flexibility, I outlined the broad goals for Card Board's flexibility. I introduced two sets of dimensions for design, for play and for communication. The dimensions of communication are taken directly from Clark and Brennan (1991) with minimal adjustment. The dimensions of gameplay are adaptations of the concepts of readiness-to-hand and present-at-hand. They are offered here as contributions to the domain of game system design.

As a part of theory on gameplay dimensions, I discuss the use of game mechanics as a starting point to make concrete design decisions. Thus, taking a simple list of card game mechanics that are common to the nine games that I mean to support, I generated a simplistic, robust, design named Design 0. It is good enough to play many games, but imperfect because its manual tedium exposes its lack of gameplay readiness.

The next conceptual iterations introduce automations that augment the system so as to be more versatile and, therefore, more gameplay ready. These features included easier shuffling, dealing, and/or knowledge of the rules of specific games. Design Idea 1 offers low automation helpers that make the common mechanics for card games easier to do. Design Idea 2 pushes on the idea of a point solution. It investigates how to add poker-specific functionality as a way to improve the optimality of the system for poker and to examine how this design move will introduce tradeoffs between a robust, general solution and a flexible system that would be able to support a very specific use-case such as Texas Hold'em.

The next section presents the actual system, Card Board and Dealer, which I implemented according to the rough guidelines for Design 1 and Design 2 described above. My implementation of Card Board itself is a continuation of my design investigation. As a design artifact, Card Board is to be both an example of flexible design and a tool for empirical study.

#### 4.5 System Description: Card Board

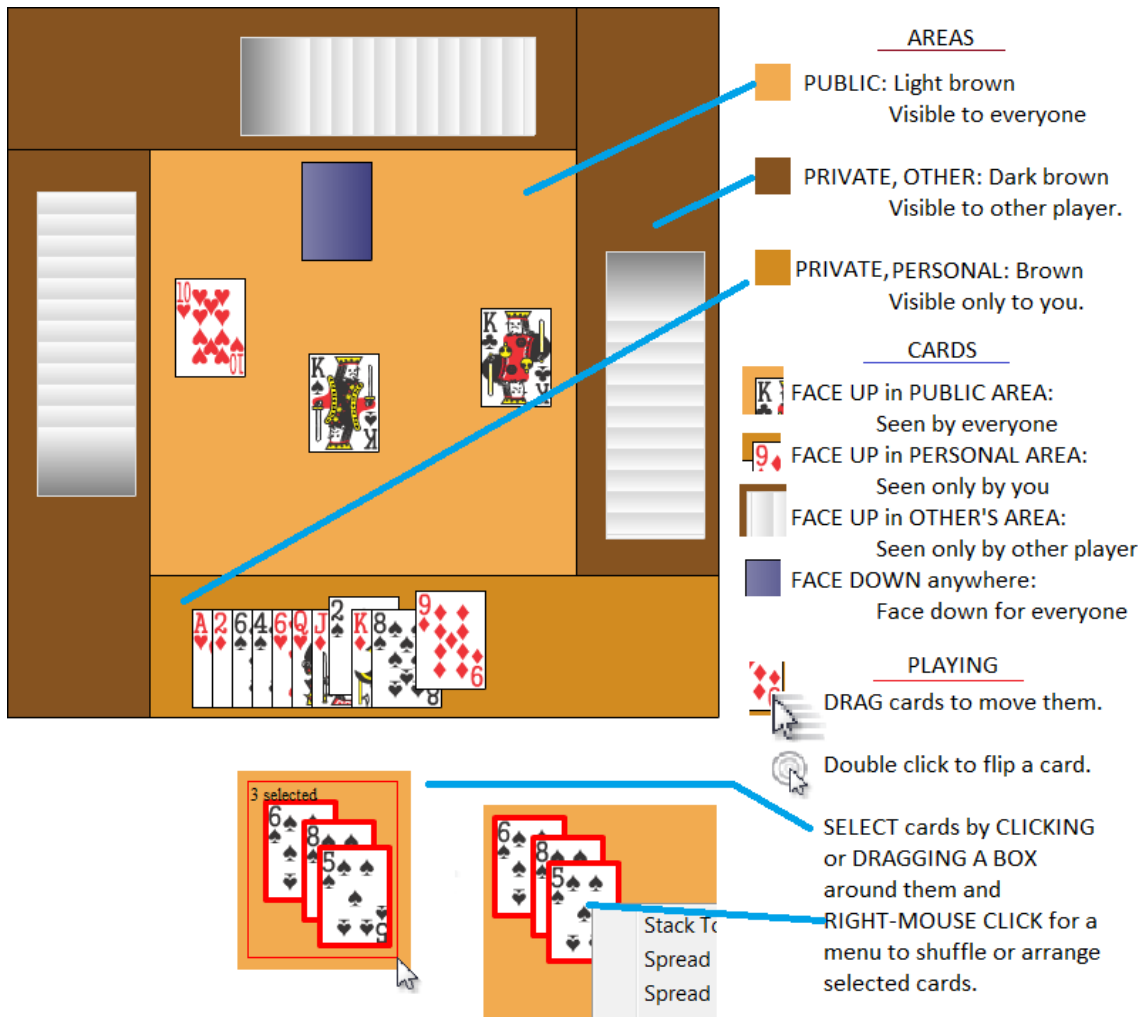


Figure 4.5 Card Board

Card Board is a multiplayer digital card deck designed to mimic a traditional card deck. It runs as a desktop client that connects with other instances of Card Board over an internet connection.

Card Board facilitates game-play by providing for shared interaction using a set of predictable primitives: public and private Areas, Cards, and Chips.

#### **4.5.1 Public and Private Areas**

In the screenshot above, Areas are the brown rectangular areas. All Cards belong to an Area.

Areas are the main mechanism for arranging cards in a visual space. They are used as a digital analog to the table and to the player's person hand.

The tan-colored Areas are public (the central box in the screenshot). All players see the same view of that Area. If a card is faced up, all players can see the value of that card. Faced down cards are hidden for all players.

The darker-colored Areas are private (surrounding the central box in the screenshot). If the Area belongs to the user, the area behaves the same way a public Area does. Cards can be faced up and faced down; the owner only sees the face up cards. If the player is not the owner, the cards are always obscured. Faced-up cards appear white, indicating that the card is visible to the owner.

Together, the private and public Areas allow for the possibilities listed in Table 4.5.1. This design allows a player to assert ownership of cards and to observe how other players are arranging or looking at their own cards. It is designed to allow these features with a minimal amount of interface cost (move or flip a card) and a minimal number of kinds of areas (mine, yours, everyone's) to keep the interface intuitive. The genericity of this solution is limited when compared to the scope of all possible configurations for physical cards. For example, it is difficult to only show your cards to two other players or to show half of a card to someone. I

prioritized simplicity and intuitiveness over fine-grained control over permissions, reasoning that this design was sufficient for a majority of cases.







		Faced Up	Faced Down
<b>Public Area</b>		 known to all	 unknown to all
<b>Private Area</b>	Personal	 known only to self	 unknown to all
<b>Private Area</b>	Other	 known only to other	 unknown to all

Table 4.5.1 *Card Board's viewing permissions for cards*

## 4.5.2 Cards

Cards are simple objects. Although they are represented with a value internally (e.g., 2H, 4D, KH), the only properties of the card that Card Board actually acts upon is the location and orientation of the card. Cards can be dragged around individually or as a group. They can be double-clicked to be flipped.

Since cards can overlap and hide each other, they are programmed to follow a predictable algorithm for deciding what card appears above another. Cards to the right (x-axis) are placed above cards left of them. If cards have the exact same x-axis value, then lower card (y-axis) appears atop.

When a single card is being dragged by the user, that card will pop in front of and behind other cards so that the player can predict how the card will drop into place.

When a card is dragged over an area, the card will change its face to preview to the user how the card will appear. This preview will not reveal the value of a card if it was originally hidden to the player holding the card.



*Figure 4.5.2 Card overlap is prioritized in order of X-axis, then Y-axis for predictable behavior when arranging cards.*

### **4.5.3 Permissions**

Anyone can move or flip any card in a public area. A player's private Area can accept incoming cards from anyone, but all other operations are permitted only to the owner.

### **4.5.4 Chips**

Chips are meant to allow players to track money and make bets in games like poker. Chips act the same as Cards except that, like physical chips, they are smaller. Chips have not yet been implemented in Card Board and do not appear in the current screenshots.

### **4.5.5 Communicative Signaling**

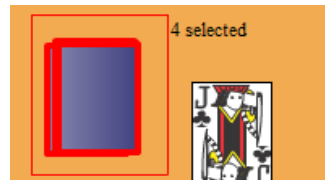
Players will be able to see the cursor movements of other players. This will allow them to gesture and point on the board. No further communicative features were planned since users were expected to coordinate via external software such as Skype during the evaluation.

## 4.5.6 Helper Functions

Card Board provides a few tools to make it easier to move and arrange cards.

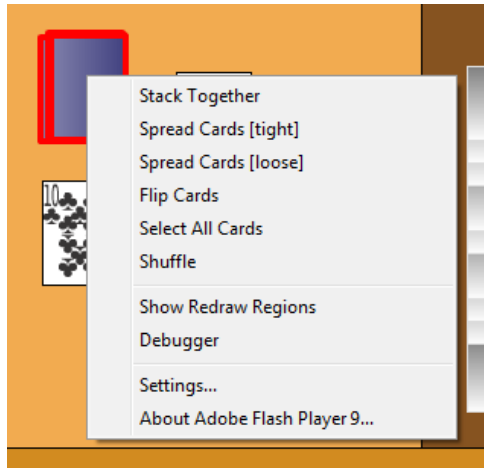
Floating text will appear when a selection box is being dragged over objects (Figure 4.5.6.1).

This helps the user know how many cards and chips are being selected.



*Figure 4.5.6.1 Floating text that informs the player about how many cards are being 'picked up' via a drag-select operation.*

A right-mouse menu (Figure 4.5.6.2) offers a “Select All” option and special functions for cards already selected. Using these menu options, a player can do the equivalent of restarting a game of Hearts by using “Select All” and “Shuffle”. He can then drag-select 13 cards at a time (as in the above Figure 4.5.6.1) and pass them out to each private Area. With his own cards, he can select them all, flip them over all at once, and spread them out to see them all. He can then drag cards around to order them. When he spreads them out again, the “Spread Cards” function will remember the order of cards based on the x-axis.



*Figure 4.5.6.2 A right-mouse menu offers a number of helper functions for managing sets of cards.*

#### **4.5.7 Design Reflection: Dimensions for Designing a Flexible, Robust, Card Deck**

Although the idea of flexibility can be discussed in various aspects of the system, the major inspiration is to create a system that can meet my three criteria for flexibility: rules, who, and when (Section 3.1). The first criterion is meant to be achieved by designing a system that permits players to play nine different kinds of card games (Bridge, Hearts, Memory, Cribbage, Crazy Eights, Rummy, Solitaire, Poker, Blackjack).

This is accomplished not by creating a specialized version for each game, but by creating a system that mimics a plain deck of cards with little to no ‘intelligence’ or automation. Aside from viewing permissions, overlapping conventions, and rotation, the Areas permit players to arrange cards however they like. This freedom or ‘flexibility’ is intended to allow players to appropriate the visual layout to convey where cards can be stacked and spread out as the players wish for them to represent the state of the game. For example, in a game of Hearts, players can place the tricks that they win in their own Area or the main Area, wherever they like. This

expected strategy is reminiscent of Kirsh's (1995) examination of how people use spatial arrangement of objects to simplify mental work. Following this, I expected players use the positioning of cards and chips as a means of recalling the rules of the game, just as in analog card sessions.

As I designed and implemented version 1, Kirsh's work directed me to prioritize the players' capacity to arrange cards freely. For example, in an early iteration, cards automatically snapped into each other to create a hand. However, I found that this paradigm conflicted with other ways to arrange cards on a table. Solitaire requires cards to be arranged vertically. Some players stack their cards in alternate meaningful patterns such as the tricks that have been won in Bridge. At the time, I recognized a design choice. I could either continue to fine-tune the auto-snap/grouping of cards to support a variety of play styles or I could take a freeform approach.

In retrospect, this decision highlighted a tradeoff between versatility and robustness; and, furthermore, it sensitized me to the recognition that even simple automated helpers such as snapping can lead to tradeoffs in versatility and robustness. Furthermore, it is not clear that my choice is the only approach. Given careful design, it may be possible to uncover a set of interaction methods for arranging cards that snap together easily and maintain versatility across a wide array of use-cases.

A final point in this reflection on Design 1 is that, while Kirsh inspired me to choose between design approaches, I found that Thomas Green's work on Cognitive Dimensions of Notation (Blackwell & Green, 2000; Blackwell, A.F., Green, 2003; Green, 1989) offered concrete dimensions for evaluating Card Board's card arrangement paradigm. Card games are information games. The ability to show, hide, and arrange cards into meaningful displays and to re-arrange

them easily and quickly are essential skills that form the basis card play. This provides the gameplay readiness that players expect to be able to play. Green asserts that the cognitive dimensions of notation can apply to interface design (Blackwell, A.F., Green, 2003) and, I have found this to be the case. These dimensions are a collection of concepts that make up a design vocabulary for the cognitive aspects of composing and editing a document. In Card Board, the elements to be composed are cards and chips. It takes effort to move them into place and to rearrange them. In the table below, I have collected insights from my design process and shown how these dimensions have been applicable.

Dimension	Definition	Examples from to the design of Card Board, Design 1
Viscosity	Resistance to change	When a player first receives his cards, they are unsorted. How difficult is it for him to rearrange the cards into the order that he wants? Possible helper features include “sort by suit/rank”.
Visibility	Ability to view components easily	A computer monitor is smaller than a physical table top. How can we offer enough space to see all of the game pieces and arrange them? How small can a card be to be easily seen?
Premature Commitment	Constraints on the order of doing things	(Less applicable in Design 1 than Design 2)
Hidden Dependencies	Important links between entities that are not visible	An early version of Card Board had cards snapping together in a row. This also included an internal “next card” and “previous card” property per card. Presumably this would allow the system to be aware of card hands. Should players be able to see these links?
Role-Expressiveness	The purpose of an entity is readily inferred	Is it clear that the different playing zones are public and private? How should players be aware that an opposing player is looking at their private cards or is keeping it faced down?
Error-Proneness	Notation invites mistakes and the system give little protection	(Shown during the user studies) Accidentally flipping cards or moving cards has proven to be an issue.
Abstraction	Types and availability of abstraction mechanisms	n/a
Secondary Notation	Extra information in means other than formal syntax	Should Card Board allow annotations to the game board?
Closeness of mapping	Closeness of representation to domain	n/a
Consistency	Similar semantics are expressed in similar syntactic forms	Picking a sort order for how card overlap each other will provide consistency in how cards are displayed. This consistency restricts a little bit how cards can be arranged on the board, but makes the arrangement simpler to use.  (Regarding Design 2) Will the introduction of automatic features add a new interaction paradigm and confuse the user?
Diffuseness	Verbosity of language	n/a
Hard mental operations	High demand on cognitive resources	See Kirsh discussion above
Provisionality	Degree of commitment to actions or marks	When players drag a card and want to arrange each card carefully, instead of just floating the card over the board, offer a preview of how the card would display (underneath or above the cards around it).

*Table 4.5.7 Cognitive Dimension Review of Card Board*

As can be seen in the above table, these dimensions offer a rich lens for evaluating the interaction costs for creating a gameplay ready digital card game environment. They also show promise for evaluating Design 2.

#### **4.5.8 Limitations regarding Flexibility**

Many properties of Card Board can be assessed negatively against flexibility. The Areas are not adjustable. No additional cards can be added or customized. There is no provision for custom game pieces or tokens that some card games require.

I have found that goals for flexibility ought to be clear because the space of potential rule-changes is enormous and subject to new expansion wherever new needs appear. Despite inflexible aspects of Card Board, the aspects that are flexible allow me to sufficiently explore my research questions.

As designed, Card Board is meant to meet the specifications of flexibility established earlier: able to facilitate a list of 9 different card games via a generic system of card-playing.

## 4.6 Design 2, Dealer – Further Benefits of Automation



Figure 4.6.1 Card Board with Dealer Components

The Dealer suite introduces two automatic components, a Bet Tracker and a Community Card Zone to support vying-style poker games, and specifically, Texas Hold'em.

These components are informed by design principles from the Coordial project (Cheung et al., 2013). From the theory elicited from Coordial's design investigations, I draw on four relevant properties: dispensibility, live-tweakability, tangibility, and value. I apply these properties in the following manner:

- (1) To be dispensible means that the Bet Tracker can be ignored by the players if they don't like what it is doing. For example, the automatic functions can largely be ignored.

There is only one trigger that will cause the Dealer components to move the players chips and cards. That trigger is to drop the yellow chip in the center of the board. If the players avoid doing this, then the automated version of Card Board will exactly like its manual counterpart. By putting control of the trigger in the players hands, dispensibility is achieved.

(2) Live-tweakability means that, once the Dealer suite is enabled, nothing among the capabilities of the suite require a drastic interruption to the flow of the game.

(3) For tangibility, following along Design 1, Design 2's main interaction paradigm is direct manipulation. This is chosen to continue with the consistency of the interaction method.

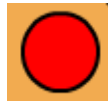
(4) The components add value by automating tedious tasks, calculations, and offering novice players a digital crutch to learn how to play.

The Dealer suite is meant to approach many of the automatic features of existing solutions such as Yahoo!'s Texas Hold'em by tracking the progress of the game, tracking the bets of players, collecting chips, and determining the best hand among competing players. It accomplishes this by instrumenting the red and yellow chips and the cards with semantic value and by taking control of the board to move chips around automatically.

#### 4.6.1 Cardboard with Dealer Scenario: Texas Hold'em

The follow scenario illustrates my envisioned use of the Dealer component as a semi-automatic game system. I have integrated notes as bordered text boxes that clarify which aspects of Card Board are expected to be manual or automatic and the rationale that accompanied this decision.

##### *The Red Dealer Chip*



**Auto:** “dealer”, “small blind”, “big blind” appear in each player’s text box automatically.

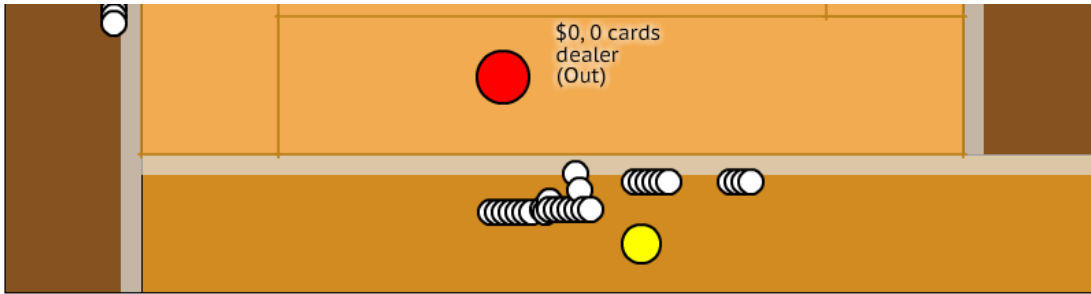
**Manual:** These labels are not enforced. Players can read them as reminders, but are not forced to follow them.

The Red Dealer chip is tracked by the game system, but can only be moved by the players themselves.

**Rationale:** A dealer chip allows the automatic system to know where the betting starts. As designer, I judged this to be a required component. To stay consistent with the interaction paradigm, I chose to have the Dealer chip to be a piece on the board. The small blind and big blind style of betting is not a universal rule and alternative betting methods are commonplace. Thus, I chose to have the labels for small and big blind appear as text, but not to force players to bet in that style.

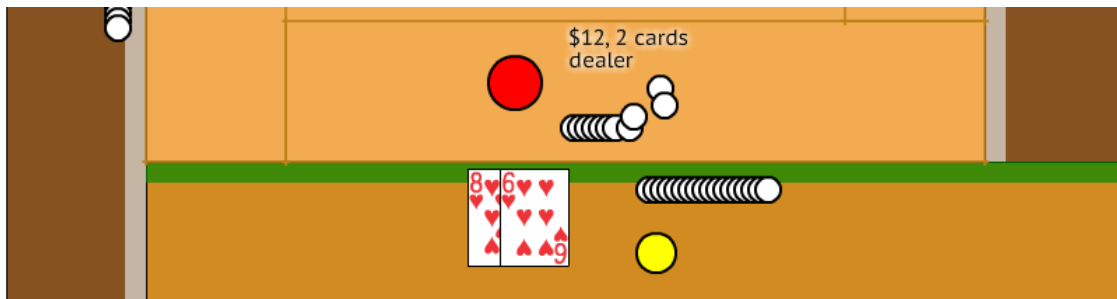
Andrew, Brian, Caylin, and Daniel log into a game session. Card Board has been configured to play Texas Hold'em. Special Smart Zones and specialized chips are active and in play. The cards are shuffled and everyone has started with an equal number of chips.

As the lower figures show, Andrew has the role of the dealer for this round. The red Dealer chip is the light colored “Zone” in front of him. Card Board is aware of the location of the Dealer chip and so automatically assigns the label “dealer” to him (as seen in the screenshot), “small blind” to Brian, and “big blind” to Caylin.



*Figure 4.6.2 The grey bar and the “(out)” text show whether or not the system recognizes the player as in or out of the game. In this case, since the player has no cards, he is considered out.*

In front of each player, on the public table, is their personal “Zone”. The system is aware of chips and cards. At the moment, no one has cards and everyone is considered “(Out)”. Andrew deals two cards into each player’s zone. A green bar lights up and the counter in their area reports that 2 cards are detected in each player’s area.

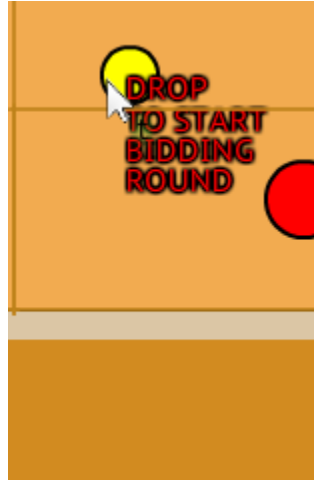


*Figure 4.6.3 The green bar and the shows whether or not the system recognizes the player as in or out of the game. In this case, since the player has cards and chips, he is considered in.*

#### The Yellow “current-player” chip: the nexus of the bet-tracking system

The players look at their cards. After a few moments, Andrew asks if everyone is ready to bet. Everyone is; so, he drags the yellow chip over the center. Before he drops the chip, red text appears over it telling him to “Drop to start bidding round”. He drops the yellow chip. The Bet Tracker takes control. First, it calculates who the current player should be and automatically moves the yellow chip into the private

area of the player who should be opening the bid. Also, it writes to the game log, “A Bidding Round has begun!”



*Figure 4.6.3 If a player drags the yellow chip over the middle area without dropping it, during informational text will appear over the yellow chip to inform him what automatic steps will happen if they drop it. In this case, the bidding round will start.*

On their turn, each player drags their bets (white chips) into the personal Zone in front of them. When they have finished their bid, they drop the yellow chip into the center to finish their bid. (Figure 4.6.4 shows the floating text that appears when players drag their yellow chip over the center area.) Once the yellow chip is dropped into the center, the Bet Tracker will take control.



*Figure 4.6.4 If a player drags the yellow chip over the middle area without dropping it, during informational text will appear over the yellow chip to inform him what automatic steps will happen if they drop it. In this case, since the bidding round is in progress, dropping a chip will finalize the bid and will trigger the next step (e.g., next player’s turn or collecting all the chips into the betting pot).*

A typical betting session occurs:

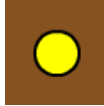
1. Brian drops 2 white chips in his personal zone.
2. He moves the yellow chip into the center. This means that he has finished his bid.
3. The yellow chip takes over, records Brian's bid in the log, and moves itself to the next player, Caylin.  
Caylin.
4. Caylin does the same: 2 white chips, and yellow into the center.
5. The yellow chip reacts the same: records the bid and determines that bidding is to continue.  
Yellow chip to next player: Daniel.
6. Daniel does the same: 2 white chips, and yellow into the center.
7. The yellow chip reacts the same: records the bid and determines that bidding is to continue.  
Yellow chip to next player: Andrew.
8. Andrew does the same: 2 white chips, and yellow into the center.
9. Yellow chip determines that the betting is over (bets all have been called) so it collects the bets into the Betting Pot zone, returns the yellow chip to the dealer, and writes to the log: "All bets are called. Betting is round over. \$8 from Brian, Caylin, Daniel, Andrew."
10. Also printed is a reminder to the dealer (Daniel) that the next phase it up to him: "What's next, dealer? Deal cards? Showdown?"

```
A Bidding Round has begun!  
T3's bid is $2  
T1's bid is $2  
All bets are called. Betting is round over.  
$4 from T1 T3  
What's next, dealer? Deal cards? Showdown?
```

*Figure 4.6.5 The log of activity along the side shows the system's interpretation of the game moves. This includes prompts for the players to decide what next to do.*

The first round of bidding is over. Andrew then flips three cards out in the center as the flop and drags the yellow chip into the center again to start a new round of bidding

#### The Yellow Chip



**Auto:** Once the yellow chip is dropped in the center, the Bet Tracker reviews what has changed. Based on this information, it determines how much someone has bid and, if all bets have been called, it will end the bidding round, move all the chips in a designated zone at the center of the table and move the yellow current player chip back into the dealing player's hand. Otherwise, the yellow chip will be moved into the next active players area and it will be his or her turn to bid. If there is only one active player left in the game, it will declare that player the winner in the game log.

**Manual:** In most games of Texas Hold'em the first bid is offered to the player after the Big Blind. However, Card Board does not do this, instead offering the first bid to the first player after the dealer. This is to allow players to choose to play with different betting systems such as an ante.

Players can avoid triggering the automatic portion of the Bet Tracker as long as they don't drop the chip in the center of the board.

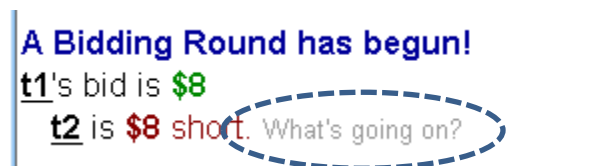
If the yellow chip is moved directly into a player's private space, this will change the current player without activating the processes that would have moved chips against the players wishes.

**Rationale:** The collection of bets is considered tedious enough that players would rather allow the automated system handle it than themselves.

Also, the only time anything moves automatically inside Card Board is when triggered by the drop of the yellow chip. In this way, players can be confident that nothing will happen automatically without their permission.

### A Mistaken Play.

As the rounds continue, the bid grows too high for Brian's comfort. He proclaims aloud, "I'm out! You guys are too rich for my blood!" And, before anyone can say anything more, he heads to the bathroom. "I'll be right back," he says, and tosses the yellow chip into the center. Unfortunately, Brian forgot to throw his cards into the center, too. To the Bet Tracker, it looks like Brian is still in the game. It tries to continue the game as normally as it can, not able to interpret what happened. It moves the yellow chip to the next active player, but asks a question in the Game Log: "t2 is \$8 short. What's going on?" The rest of the players notice the discrepancy and remove Brian's cards for him.



*Figure. 4.6.6 If something happens outside of the game's capacity to interpret, such as an incorrect bet amount, the system alerts the players but does not block the players from playing as they wish.*

*"What's going on" and Free permissions*

**A Bidding Round has begun!**  
t1's bid is \$9  
t2's bid is \$8  
t2 is \$1 short. What's going on?

**Auto:** Recognizing a discrepancy in the bidding.

**Manual:** Interpretation and resolution is in the players hands.

**Rationale:** This prompt is necessary because the system cannot determine what the issue really is. The alert is also fashioned in a way that will not disrupt the game flow.

By the last round, only Andrew and Daniel remain. Both seem confident of their hands and the bidding reaches a showdown where both players reveal their cards to see whose five card combination is the best. Daniel drags his Jack and Ten into his personal Zone and the Community Zone automatically detects his best poker hand, a Three of a Kind (see Figure 4.6.7), which is given a rank score of 1895. Gleefully, Andrew reveals his Queen and Ten, the Full House is the 217<sup>th</sup> best possible hand in poker. Daniel's groan is a signal enough for Andrew to collect the \$36 dollars in chips.



Figure 4.6.7 Showdown. Player's revealed hands are evaluated by a poker hand evaluator. Their rank score is displayed as a number under the Community Zone.

*"Who has the better hand?" and Ending a round*

**Auto:** The Community Zone will score each player's hand according to its rarity as a poker hand. This is displayed as text in the center of the board. (e.g., "t1: Full House, 217")

**Manual:** Card Board does not declare a winner nor does it disperse chips to the winner. These are done manually.

**Rationale:** There exist a number of variants of Texas Hold'em where the end of the game is determined by an unusual scoring method, betting method, and bet distribution method. As such, the better choice at design time appeared to be to leave the interpretation of the hands and the distribution of the chips as a manual task. This is also why the hand evaluation tool is purely descriptive. Players get to see the poker "value" of the hand, but if players have house rules about cards (such as treating a card as a wild card), the ranking system could be ignored.

My aim with this scenario is to show the similarities and differences between Card Board with Dealer is from the typical automatic version of Texas Hold'em would be. There is a high level of communication required to coordinate the game as well as initiation from players to decide the rules of the game and how what to do when the system is not in control (e.g., showdowns or mistaken plays).

What follows now are more details about each automatic component of Design 2.

#### **4.6.2 Tracking the state of the game: Game pieces and Zones**

In this version of Card Board, the software leverages more of the semantic meaning of the cards, chips, and areas. This allows the system to track the state of the game.

Playing cards have a rank (Ace to King) and a suit (Clubs, Diamonds, Hearts, Spades). Chips have dollar values. The large red chip is recognized by the system as a “dealer” chip. Whoever possesses the dealer chip is identified to the system as the human “dealer”. The yellow chip is recognized as the “current player chip”. Whoever possesses the yellow chip is consider the current player.

In the manual system, different Areas on the board are designated as public or private. Overlaid over the central public Area are smart “Zones” that segment the table top into personal areas. Compared to a real life experience of playing cards, these zones are like the personal space that in front of a player that is understood to belong to them or specific spots on the table that have semantic meaning such as the pot in poker.

These “Zones” have a tan-colored border. Unlike Areas, they do not have a hard edge to them; a single card might intersect two Zones by accident. Zones have a text box attached to it that report

information about the Zone. Intelligent components in the software take advantage of the Zones in two ways. First, they use it to track where game pieces are on the public portion of the table (e.g., in front of which player are these chips?) and they use the text portion of the Zone to report information about the game state.

### 4.6.3 Personal Zone

This component tracks the cards and chips to help determine the game state. The player’s current bet and number of cards is displayed in the Zone’s text box. The text shows if the player is the dealer, small blind, or big blind. Also, during a game of poker, the Personal Zone reports whether the player is still in the round or not (“in” or “out”). The criteria for each of these states is described in Table 4.6.3.

<b>Criteria</b>	<b>Status</b>
<i>Is this red Dealer chip in our Personal Zone or Private Area?</i>	“Dealer”
<i>Are we left of the red Dealer chip?</i>	“Small Blind”
<i>Are we left of the small blind?</i>	“Big Blind
<i>Has the current player chip?</i>	“YOUR TURN”
<i>Has no cards?</i>	“Out”
<i>Has cards?</i>	“In”
<i>Has no money?</i>	“Broke”
<i>“In” and “Broke”?</i>	“All in”

*Table 4.6.3 Determining factors for the information text in each player’s Personal Zone*

#### **4.6.4 Bet Tracker & Betting Pot Zone**

The Bet Tracker facilitates a game of Texas Hold'em. The vision of Bet Tracker is to behave similar to a human dealer who will help everyone play Texas Hold'em by reminding players of their turn, keeping track of the highest bid, and collecting the bids into the center when players have finished the bidding round. Additionally, to retain flexibility, Bet Tracker is envisioned to be lenient, making room for mistakes by players and allowing players to play variations of Texas Hold'em if they wanted.

As the designer of Bet Tracker, I decided that this could be achieved by having Bet Tracker wait until the players call upon it to act automatically. Thus, Bet Tracker does nothing unless it is triggered by a particular action: dropping the yellow current player chip into the center of the board. Once triggered, Bet Tracker will evaluate the state of the game pieces to determine the next stage in betting that would occur during a poker game.

According to Bet Tracker, there are only two states.

1. WAITING FOR DEALER
2. WAITING FOR BIDDER

WAITING FOR DEALER means that a round of betting has not yet begun and it is up to the dealer to decide what to do before starting a round of betting.

WAITING FOR BIDDER means that a round of betting has begun and any moves of the game pieces need to be interpreted according to how they affect the bidding.

Table 4.6.4 describes what Bet Tracker takes into account when it has been triggered by a yellow chip thrown into the center.

State	Effect
<b>WAITING FOR DEALER</b>	
<i>At least 2 players with chips and cards?</i>	Move Yellow chip to the next player Log: "A Bidding Round has begun!" Game state: Waiting for bidder
<i>Not enough players in the game?</i>	Log: "Need at least 2 players with cards & chips to start."
<b>WAITING FOR BIDDER</b>	
<i>Did this player check, call, or raise?</i>	Move Yellow chip to next player Log: "Bid is \$X"
<i>Did the player raise and have zero chips in his private Area?</i>	Log: "Player is ALL IN."
<i>Did this player bet too low?</i>	Move Yellow chip to next player anyways Log: "Player is \$X short. What's going on?"
<i>Did this player fold?</i>	Move Yellow chip to next player Log: "Player folded."
<i>Have all bets been called?</i>	Collect bets into center Move Yellow chip to back to the dealer Log: "All players have (checked/called). Betting round is over." Log: "What's next, dealer?" Game state: Waiting for dealer
<i>Is there only one player in?</i>	Log: "Player wins!" Game state: Waiting for dealer

*Table 4.6.4 When a yellow chip has been thrown to the center, the bet tracker wakes up and decides what to do on the basis of the game state: a combination of its internal state (waiting for dealer or waiting for bidder) and the pieces on the game board.*

#### 4.6.5 Community Zone

The Community Zone evaluates the quality of players faced up cards. The rules of Texas Hold'em are that players find the best five card combination out of their two private "hold" cards and five shared "community" cards. In a typical manual game, the players must recognize the best combination themselves. In a typical automatic system, the computer will judge who the

winner is. This leads to a difference in how a game is played between automatic and manual systems because manual poker games must account for player error. For example, what happens if a player does not recognize the best possible hand such as claiming a pair when one has a straight? Some variants of poker emphasize that players have to call out what they are playing. If they don't see the straight, then they don't get its benefit.

To explore this difference the Community Zone offers a Texas Hold'em poker hand evaluator. When the combination of the cards inside the Community Zone and a player's Personal Zone is five or seven, the evaluator will report the rank score of the best possible hand. This is the "Cactus Kev" ranking system<sup>8</sup> where all possible poker hands are ranked by how rare they are: the rarest being the straight flush (rank 1).

Players are intended to use this feature during the showdown stage, when players reveal their hole cards to see who has the best poker hand. It will act as an informative tool, but will not control any automatic declaration of a winner.

#### **4.6.6 Game Log and other informative text**

The Game Log reports the automated system's interpretation of the game state. It will state when a bidding round has started, who is in or out of a game, and raise unobtrusive questions when needed (e.g., "t2 is \$1 short. What's going on?").

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<sup>8</sup> <http://www.suffecool.net/poker/evaluator.html>

## **4.7 Reflection after completing Design 2**

To close this section, I reflect on the design challenge of building automatic components on top of Design 1. Insights are drawn from my own design experience and the design rationale that I employed, some of which has been described in the previous section.

### **4.7.1 Meagerly-supported vs. Richly-supported functionality**

First, I would like to discuss the design terms that I borrowed from Herbert Simon, “satisficing” and “optimal” as well as the terms “robust” and “versatile”. During the process of design, I recognized that these terms are best applied after user-evaluation, not before. In the context of flexibility, the designer can confirm that his design offers satisficing solutions when users actually try out the software and come up with a solution that they judge to be so. As a designer working at a stage of design prior to user testing, I resorted to slightly different vocabulary. I described an expected activity as meagerly-supported versus richly-supported.

A meagerly-supported activity is one that is not convenient to do, but for which the designers has decided to forgo an optimized solution. Its related terms are “satisficing” and “robust”. For example, in Card Board, the open ended-ness of the system makes it difficult to automatically determine who won the game. Thus, I decided to leave the end-game automation meagerly-supported. I provide tools to help players determine who won: the betting pot, community zone, and game log all give useful information, but the final determination, including the distribution of the chips to the winner are not provided features. Thus, the end-game experience is intentionally meagerly-supported.

A richly-supported activity is one that is designed to be as easy and non-cumbersome as possible to accomplish. Its related term is “optimal”. The goal of Design 2 was to produce a richly supported experience of Texas Hold’em.

These terms further clarify how versatility and robustness fit into flexible design. The larger the number of activities that are richly-supported, the more versatile the system; the more solutions exist, including meager workarounds, the more robust.

#### **4.7.2 The locus of flexibility and on recomposing an automatic feature as semi-automatic**

I reflect now on the tension between automation and manual, having moved from a naïve mimicry of a card deck (Design 0), added helper functions (Design 1), and then rule-awareness for poker (Design 2). I expect that designers of flexible game systems will need to make similar decisions that I have.

I needed to offer robustness at different levels. Design 1 was at the level of card games in general. Design 2 was at the level of poker games. At each of these levels, I designed to support a broad set of games. Design 1 was directed by a set of 9 sample card games. Design 2 was informed by my prior work on studying variants of Texas Hold’em.

Reviewing this approach, I find that it is very reminiscent of Dourish’s discussion of the levels of abstraction and locus of flexibility (Dourish, 1996). In my work, there were two loci of flexibility: one, for cards in general and the other for poker games. Dourish’s main concept is the idea of levels of abstraction in programming. And, although Design 2 is not exactly an abstracted

layer above Design 1, it did build upon many established interaction conventions from Design 1: chips having meaning, meaningful Areas and Zones, and informational text.

The idea of abstraction did apply better for implementing of some of the helper features for Design 1. The most clear example of this is my helper function for arranging a group of cards. Since I had abandoned a structured representation of a set of cards (a linked-list) in favor of having cards laid out anywhere, without snapping into a structured layout. I had turned to helper functions for arranging cards on the table: shuffling cards, stacking them together, and spreading cards out horizontally and vertically. I saw that I could create a generalized function for these three. The difference between shuffling, stacking, and spreading cards was small and could be distinguished with the following variables:

- a) Where to put the first card
- b) Where to put each next card (dx, dy, and amount of random jitter)
- c) Should the cards remain sorted or be shuffled?
- d) Should the cards be flipped down or be unchanged?

To shuffle, arrange the cards vertically (dx=0, dy=2) with a little jitter as a visual cue. Have the function shuffle the order and flip the cards down.

To stack cards nicely, arrange the cards vertically, no jitter, do not re-order, flip the cards down.

To spread the cards out as if in your hand, arrange the cards horizontally (dx =40, dy=0), no jitter, no reordering, keep the cards as they are faced.

As the design progressed, I expanded this functionality to spread cards vertically (as if for a game of Solitaire) and to stack chips in rows of ten. Looking ahead, this function can be adapted for automatically dealing cards as well.

It appears that users picked up on the general possibilities of this function. In piloting sessions, participants constantly fiddled with the arrangement of their cards while waiting for their turn. They found it to be an enjoyable experience as they rearranged cards and chips. In a playful moment, one participant found that he could “shuffle” his white chips and soon everyone in that session was playing with the stacking options. Here, the interface for stacking is a simple menu list of five varieties of stacking (vertical, spread tightly, spread loosely, shuffled, piled), but that was sufficient to encourage playfulness and unexpected activity. Looking into the future, I would find a way to expose these variables in the interface to allow players to define the stacking variables themselves. This may even be possible within the same interaction paradigm of Design 1 and not require complicated scripting or configuration.

To review, this function highlights how automation and robustness might fit together. In this situation, I decomposed a set of automatic tasks into individual variables. If I can expose these variables to the user, I can offer both genericity that is “manual” and “automatic”.

Returning to Dourish’s terminology, I believe that Design 1 represents a clear focus on a location for flexibility. This is done by identifying a guiding set of variant activities that need to be supported. In game design, these activities are game mechanics. This set helped me identify tasks that seem cumbersome across many of these activities and that would benefit from automation. Then, among the automated tasks, I sought commonalities that allowed me to recompose an automatic action into a generalized form (stacking). This pulled me back from full automation

into a semi-automatic approach. With the initial version, there were already signs that players were comfortable appropriating it for themselves.

### **4.7.3 Necessary Manual Modes: Where Automation and Semi-automation fail**

Continuing this reflection on the design choice between automatic and manual, Design 2's requirements introduced me to a new challenge. I could not find a fully automated solution for end-game scenarios and for betting. Two factors increased the complexity of finding a fully-automated solution.

- 1) Variations were too diverse, making it impossible to account for everything programmatically. At the end of a game, the possibility for variants such as wild cards, high-low options, special rules about community cards all made it all but impossible for an automatic system to determine who won the game.
- 2) The openness of the underlying Design 1 led to new "broken" states of play that require human interpretation. The open system made it possible for game states that are otherwise never encountered in fully automated game systems. If players did not bet enough, it was impossible to determine whether the player meant to fold or check. Without human interpretation, the system would not have enough information to move forward.

In these situations, I resorted to prompting the user with a "what now?" question that included information about the game state (e.g., "Player X is \$1 short."). In the interest of keeping the game in flow, I did not freeze any elements of the game experience. For example, if ignored, the

complaining bet tracker and its yellow chip would continue to operate as normally as it could. This is in line with the live-tweaking principle for flexibility.

## **4.8 Summary**

In summary, my design work for Card Board offers the following contributions:

- a) Identifying the relevance Kirsh (Kirsh, 1995) together with the Cognitive Dimensions of Notation (Green, 1989) in the process of designing and implementing Card Board.

Kirsh's work directed me to prioritize the players' capacity to arrange cards freely.

Green's work helped me realize that vision. It gave me a design lens for making concrete design decisions about how to create a user interface for freely arranging and rearranging cards.

- a) Two design terms that parallel my terms for evaluating flexibility: "meagarly-supported" and "richly-supported".

These terms emerged from my perspective as a designer who was trying to create a solution that was robust and versatile. It was more concrete at this phase in design to consider these features as different kinds of support rather than as robust features or versatile features.

- b) A recipe for how to reconstitute automatic features as semi-automatic features which is, in short:
- a. Pick a locale of flexibility which is a baseline for your design. In Card Board, there were two baselines: Design 1 covered general card games, Design 2 covered poker games.
  - b. Take the list of automatic features that would typically exist above this baseline and decompose them into common functionalities.
  - c. Find a way to offer an array of those functionalities to the player as a unified general function.
  - d. Warning: Be willing to leave some of the overall system manual, understanding that manual modes may be necessary in a flexible system.

My next step was to evaluate Card Board through play-testing as a way to produce further insights on flexibility.

## 5 User Study

This is a report of the evaluation of Card Board that will help draw the connection between the design work and the anticipated freedom of play that players can accomplish with it. Its intent is to collect gameplay behavior that will inform our understanding of system flexibility and rule-negotiating behavior. This study is exploratory, using qualitative methods to discover aspects of rule-negotiation that are not widely understood. The goal of the user study is to provide empirical data for my research questions. I have restated them below to frame the user study in the context of my dissertation as a whole.

*[RQ1.1] In what ways do the design strategies of robustness and versatility facilitate playable game experiences?*

This research question has been largely addressed by the design work prior and will not be the primary focus of this user study.

*[RQ1.2] In a flexible digital system, what communicative features are important for the negotiation of rule-changing by players?*

This question will be of direct interest for the analysis of communicative activities using the communicative dimensions as a thematic guide.

*[RQ2.1] What tradeoffs can be expected when comparing a general game system (i.e., a generic playing-card simulator) against a fully-automatic, yet rigid, solution (e.g., Yahoo! Bridge)?*

*[RQ2.2] How can semi-automatic components be added to a robust game system to improve the versatility of a game system?*

*[RQ2.3] Given that flexible strategies do not necessarily overlap, what tradeoffs can be expected when a system is being designed both to be robust and semi-automatic?*

These questions will be addressed via counter-balanced exposure of Card Board and Card Board with Dealer for participants. The comparison against a fully-automated solution will be investigated via interview by asking the players to compare their user-study experience against their prior experience with digital card games. The result will be that participants will be exposed to a diverse set of flexible strategies and allow me to examine the role of key design themes such as manual aspect and automation within a multitude of contexts. Note that I will be employing qualitative methods for analyzing these design themes to understand how they work together or against each other. This is better suited for untangling the data since there are manual aspects to Card Board with Dealer and there are semi-automatic features (such as shuffling) in Card Board.

*[RQ2.3] Given that flexible strategies do not necessarily overlap, what tradeoffs can be expected when a system is being designed both to be general and to be versatile? have configurable, complex components?*

The user study complements the design work discussed in Chapter 4 that informs this question. The user study is designed to expose half of the participants primarily to Design Idea 1, with a brief introduction of the opposing system and the other half with the same procedure for Design Idea 2, then 1. An analysis of player behavior will inform the discovery of tradeoffs.

## **5.1 Participant Recruitment, Screening by Personality**

Participants were recruited in groups of 4 to participate in a user study of a computer card game system named ‘Card Board’. They were recruited from University mailing lists, paper flyers and online communities such as Facebook, Reddit, and Craigslist.

### Personality

The related work from Game Studies on playground games suggests that social dynamics (Hughes, 1983) will play an important role in the experience of Card Board. From a software designer’s perspective, Card Board leaves too much to unrestrained. Malicious players can spoil the experience for other players: cards can be stolen, rules ignored. Additionally, because there is not much research on rule-changing in general, an initial concern for this user study was whether or not players would “live-tweak” at all within a short one hour session. Lastly, although my review of the literature suggests that rule-changing is mostly pragmatic, the idea of changing the established rules of a game seemed like a creative act, requiring talents and inclinations that are marginal, not common to the general population. In sum, initial concerns were whether or not the participants would be cooperative, change rules, or be creative enough.

In response to these concerns, I screened for a certain personality type among participants. This was in the interest of seeding the participant pool for cooperative play and for isolating personality traits to help interpret player behavior. The knowledge of the personality profile of my participants offers markers by which to judge the transferability of my findings (Lincoln & Guba, 1985).

However, being overly-restrictive with the screener would have made recruitment impractical. Thus, I focused only on the idea of cooperativeness since this was the more critical among the initial concerns above.

Participants were screened for above-average scores on two Big 5 personality traits:

Agreeableness and Emotional Stability according to their score on the Ten Item Personality Inventory (Gosling, Rentfrow, & Swann, 2003). These two traits indicate a positive correlation to satisfaction in small group work (Peeters, 2006) (group work is a similar circumstance that participants experience in the study). Cheating behavior in children is correlated with social rejection (Rubin & Hubbard, 2003). This spoiling behavior would be screened out by requiring above average scores for agreeableness and emotional stability. Forgiving behavior in games is also correlated with emotional stability (Li & Chen, 2012). These reasons support the expectation for successful completion of the study procedures as well as cooperative behavior during the group experience of play and social negotiation of rules.

Later, I return to the discussion of personality in light of the findings from the study.

Additional details were collected in the screening process:

- a) Participants general card-playing motivations (gambling, skill, or social)
- b) Experience with the card games Texas Hold'em, Draw, Stud, and Blackjack
- c) Experience with Dealer's Choice and online card games

## **5.2 Study Procedures**

Qualifying participants were scheduled to join a group and invited to come into a lab setting to play Card Board. There were two types of groups. One set of groups played primarily with Design 1. The other played with Design 2. The following procedure list was employed:

1. Preparation before coming into the laboratory
  - a. Participants were placed in either a Card Board or a Card Board with Dealer group.
  - b. Participants were emailed with a link to an information website about the basic use of Card Board that included
    - i. Instructions for Card Board and Card Board with Dealer
    - ii. A demo that was running a single instance of Card Board with Dealer and instructions.
2. Study
  - a. Setup
    - i. Participant group was invited for a session totaling 1.5 hours.
    - ii. Participants each were assigned to a laptop computer running Skype and a networked session of Card Board. Each station was separated by cardboard dividers. Players were given headsets.
    - iii. The sessions were audio-recorded, the game screen was video-recorded using screen capture software, and the player actions were digitally logged by Card Board.
    - iv. Session I – Initiation / Base case
      1. Players were asked to play a round of limit Texas Hold'em
    - v. Session II – Rule-changing Play I
      1. Players were asked to play 15-20 minutes of Dealer's Choice
    - vi. Session III – Rule-changing Play II

1. Players were asked to adapt a version of poker that is very difficult to manage with Card Board (Blind Man’s Bluff). The rules were provided on paper as a reference.

vii. Session IV – Free play using the alternate Design

1. 5 minute introduction to alternate Design (Card Board with Dealer [v1] or Card Board without Dealer [v2])
2. Players were asked to play whatever they’d like

b. Group Interview

- i. Group Interview – Discussions of the game-play and rule-changing and how that affected how the players behaved during the game sessions.

<b>Card Board</b>	<b>Session I – Initiation / Base case</b>	<b>Session II – Rule-changing Play I</b>	<b>Session III – Rule-changing Play II</b>	<b>Session IV – Free play with Card Board with Dealer</b>
<b>Card Board with Dealer</b>	<b>Session I – Initiation / Base case</b>	<b>Session II – Rule-changing Play I</b>	<b>Session III – Rule-changing Play II</b>	<b>Session IV – Free play with Card Board without Dealer</b>

*Figure 5.2 Session plan*

The initial sections of the study were fairly straightforward. Players were expected to be nominally familiar with the software so that they have enough understanding to play the game and change the rules of the game when the time came. Players were asked to play an initial deal of a standard game so that they would be familiar with the software and to acquaint themselves with the group.

The design of this user-study was motivated by a number of considerations.

### Rule-changing Play I

Dealer's Choice is a type of poker game where whoever deals out the cards gets to decide what to play. Each deal can be a different game. Players were expected to choose games that they personally enjoyed and to choose games that fit the group session. Players were expected to tailor the game to the interface. Dealer's Choice is a naturalistic approach to observing rule-changing over a computing medium. It helped explore the gameplay and rule-changing behaviors that the players engage in.

Additionally, players were expected to pick variations that the other players had not played before. This required them to teach the other players how to play, using Card Board in a demonstrative way to explain the game.

### Rule-changing Play II: Fine-tuning a problematic variant

This second exercise was designed to push players into a mode where they had to struggle with an inflexible aspect of a system. The chosen variant, "Blind man's bluff", contained a problem in its demands on Card Board. "Blind man's bluff" requires players to show their cards to each other without seeing the card themselves. Card Board does not have a natural way of accomplishing this kind of information control.

This forced players to wrestle with a rigid aspect of Card Board. Players were asked first to try to solve the problem without help from the facilitator.

## Freeplay using the Alternate Design

This was a simple condition to expose the players to the version of the software that they had not tried yet. This provided a chance for users to give feedback on the comparison between both designs of Card Board.

### **5.3 Group Interview**

The following are a pool of questions from which I drew during the group interview.

#### *A. Question pool regarding flexibility and tradeoffs*

- a. Compare your experience with other card game software you have used before. Was it easier to play? Would you rather have used it? How did you find the experience different?
- b. Would you want to replace any of the card games you usually play with Card Board why or why not?

#### *B. Question pool regarding game-play*

- a. Did you have fun? Why or why not?
- b. Describe how Card Board compares to other types of card game software you've used. Did they represent the game in ways that Card Board couldn't? What was your experience making up for those deficiencies?
- c. Was there anything tedious about using Card Board to play?
- d. How would you compare Card Board to a regular deck of cards?

#### *C. Question pool regarding notation (for Card Board with Dealer)*

- a. Discuss the card-pattern language – and how easy or difficult it was to modify.
- b. Discuss the context of the language – How did the script help or hinder negotiations about rule-changes? Did the script seem open to changing in the midst of gameplay? Why or why not?
- c. Discuss the execution engine and Dealer's design goal to share power with the users. Were they comfortable interrupting or correcting Dealer?

*D. Question pool regarding communication*

- a. Ask when the players got to the point where they believed that everyone was on the same page (“common ground”) about the accepted rules.
- b. Identify who (if anyone) took the leadership role in arbitrating rule-changes and ask why that person adopted that role. Discuss his or her particular methods of decision-making and how Card Board/Dealer helped or hindered those efforts.
- c. Note any communicative behaviors using Card Board as a communicative prop, discuss.
- d. Discuss out-of-band communications (not using Card Board itself).
- e. Did you feel that Card Board helped you communicate how to play the variants with the other players? How?

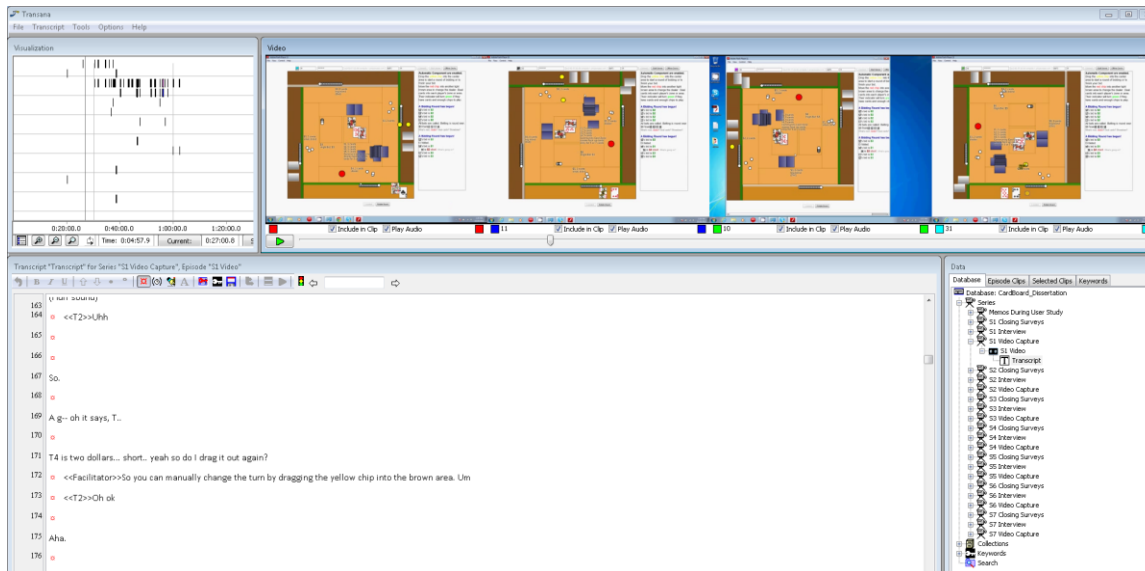
*E. Discuss comparisons between v1 and v2 of the Card Board software*

- a. How did the playing, rule-changing, or communicative experiences differ?

## **5.4 Method of Analysis**

Log file data was collected but not analyzed for this dissertation.

Interview and gameplay audio was transcribed using Transcriber (Boudahmane, Manta, Antoine, Galliano, & Barras, 2005). The screen captures of the game sessions was synchronized with the written transcription of the audio. Each session had multiple screens on display with a text transcript of the audio. An example can be seen in Figure 5.4. Data was compiled and analyzed using Transana (D. Woods & Fassnacht, 2013) . Data files were exported as a MySQL database to examine co-occurrences of qualitative codes in the data.



*Figure 5.4 Transana screenshot. Synchronized videos are paired with a transcript which is segmented into excerpts which are assigned codes.*

To analyze, I took a naturalistic approach to the data (Lincoln & Guba, 1985). I coded instances of communication, gameplay, and rule-negotiation. For communication and gameplay, I was prepared with initial themes as categories for thematic analysis (Aronson, 1994). For rule-negotiation, I took a grounded approach (Strauss & Corbin, 1990) starting only with instances of rule negotiation. I then proceeded to take the steps of open, axial, and selective coding to derive my findings.

After the codebook and analysis was finished, I sought an outside auditor to evaluate my interpretations. I described the study procedures to her including the study design, recruitment process, lab sessions, and interviews, to the analysis, codebook, and themes. She was asked to review the comprehensibility of the codes and to take a critical look at the trustworthiness of my interpretations. Following her advice, I refrained from making extreme claims about audio communication being more prominent than video communication that would overreach the method of analyzing the video data (see the next section).

## **5.5 Study Limitations**

Some players reported feeling like they were in the same room. They were instructed to use the digital channels to communicate (as if they were distant), but there were occasions when players forgot.

Due to limitations in time (a) the first three sessions did not play Dealer's Choice, (b) session #7 was introduced to, but did not play the manual version of Card Board.

Lastly, there is a potential bias towards analyzing the audio communication rather than the video communication in the game sessions. This is because the analytic process favors the audio data. The audio was transcribed and, as per the Transana system, the transcript serves as a guide for segmenting the video into excerpts for coding. As such, the analysis of the communicative patterns in this project should be considered in light of this potential bias. For example, although video-based communication may not be as prominent in the data, no assumptions should be made about it being a worse medium to communicate about the rules of the game.

## **5.6 Overview of Sessions**

Out of 77 people who took the screener, I accepted 24 participants in a total of 7 sessions. I originally planned to run up to 12 sessions. I stopped after the 7<sup>th</sup> session due to the following signs of saturation: as the session facilitator, I observed similar communicative, gameplay, and negotiating behaviors repeatedly; players were solving the Blindman's Bluff exercise in the same way; and, players were offering many of the same suggestions for Card Board in their interviews by asking for the same technical improvements and features.

7 sessions were conducted with 24 total participants. Groups of 4 were scheduled, but due to cancellations, some sessions had 3 or 2 participants in a group. Session #3 had 2 participants. Sessions #6 and #7 had three participants. All other sessions were conducted with four participants.

I ran the study with 7 alternating sessions of “auto” and “manual” versions of Card Board. An updated revision of the Card Board was used later to fix bugs and in response to early user feedback. This version helped to better facilitate the study by reducing gameplay lag and improving communicative channels. Participants were in the same room, each using their own computer. They were separated by cardboard and foam dividers and used Skype to communicate. During the sessions, their screens were recorded and their voices were recorded via Skype.

Session	# of participants	Condition (“+” for auto)	Software version	Notes
S1	4	+	r 115	No Dealer’s Choice
S2	4		r 115	No Dealer’s Choice
S3	2	+	r 115	No Dealer’s Choice
S4	4		r 117:	
			+Ctrl-select option for multiple cards	
			+Faster flipping for cards to solve problem where players accidentally flip a card twice.	
			+ Speed improvements for on-screen animations and mouse trails.	
			+ Made card selection boxes more visually obvious	
			+ Other players’ mouse shadows replaced by clearly identified mouse cursors with player names	
			+ Faster card movement animation	
S5	4	+	r 117	
S6	3		r 117	
S7	3	+	r 117	Facilitator played as a 4th player due to late arriving participant.

*Table 5.6 Sessions.*

In total, captured and collected data include:

- Screen survey data
- About 1 hour of screen capture per session, totaling 7 hours of screen capture data from multiple computer screens along with audio.
- 15 to 30 minute group interviews per session
- Post-session survey responses per participant
- Researcher notes from each session in the form of personal memos

In general, Card Board was successful at offering an enjoyable game experience and elicited useful data for analysis. Players had fun, they communicated, and negotiated the rules of the game.

Each group responded positively to the first question of the closing interview, “Did you have fun?” As the facilitator, I observed laughter and smiling in all sessions. A number of sessions closed with participants asking if there would be a public release of Card Board. Some groups continued playing when they got the chance to. For example, the players in Session 2 played additional rounds of Blindmans’ Bluff on their own volition. Participants reported the experience being much closer to playing in-person rather than an online game. This was attributed to the amount of conversation that happened and the comfort of not having to be skilled. The following quote highlights the perceived difference between online games and Card Board: “I have played Farmville. And that is a social game except that you don't actually ever interact with anybody. You will have farms and this is somebody else's farm, but you don't do things together or talk with people. I've played some iPhone games where you have turns and take turns, but you don't talk to each other.” – Sherry (Session 1, Player 3, Closing Interview) These signs show that the software did prove to be successful despite being a prototype.

Participants all had comments about the interface of Card Board. They had much to say about small interactive details of card manipulation. Opinions diverged on whether or not Card Board moved too slowly for them to enjoy the game. Much of the system was cumbersome in the network lag or waiting for the automatic features (shuffling animation, moving yellow chip) to move elements. However, some reported that the pace was not very different than physical cards and sometimes faster. Shuffling, for example, is faster than shuffling real cards.

During the interviews participants had less to say about rule negotiation. There were comments about the freedom to play whatever you wanted, but this did not spark much speculation about new ways to play or unusually creative play. As the grounded analysis below shows, the act of rule-negotiation did occur. By examining the gameplay sessions, I found many instances of rule-negotiation for analysis. It may be that this activity is seen as a very normal part of getting an analog card game to work and is not something that participants found easy to reflect on.

### **5.6.1 Participants**

Participant ages ranged from 18 to 65, with a median age of 27 years. There were 15 male participants and 9 female participants. Survey responses to the screening questionnaire are collected in the Appendix B. A closer look at the personalities the players is in the next section.

In the closing surveys, participants were asked to report on their experience with both Design 1 and Design 2. Likert scale answers were collected for the level of challenge that the games presented, their sense of skill with the software. Averages for these numbers are presented in Chart 5.6.1.4. It appears that the automatic features presented a higher learning challenge for participants. In response to the ease of use of Skype to discuss the rules of the game, the total average was 1.70 on a scale of 1 to 5 (1 being easiest). In the survey, participants had a little

trouble with identifying speakers and with technical issues such as voice echo, but otherwise saw the audio as helpful.

	Using Card Board, how challenging were the games of poker (consider them all together) that you played?	Using Card Board, after playing for a while, how skilled would you consider yourself at using the Card Board software itself?	Using Card Board with automatic features, how challenging were the games of poker (consider them all together) that you played?	Using Card Board with automatic features, after playing for a while, how skilled would you consider yourself at using the Card Board with automatic features itself?
Card Board group (Sessions 2,4,6)	2.9	3.9	2.36	3
Card Board with Dealer group (Sessions 1,3,5,7)	2.18	4.09	2.69	3.84

*Chart 5.6.1.4 Averages for experienced challenge & skill during the study.  
(1=lowest skill/challenge, 5= highest skill/challenge)*

### **5.6.1.1 Group Dynamics, Leadership, Personality**

Due to the importance of the communicative and social aspects, it is relevant to highlight the role of group dynamics, leadership, and personality in the overall experience of the system. Thus, I am presenting my observations of the group dynamics for each session. The survey responses are offered as a way to interpret my observations of the group dynamics during each session.

These statistics are offered primarily as markers to understand the nature of the data collected and to help the reader determine the transferability of my findings. This follows with Lincoln and Guba’s (1985, p. 124) emphasis that transferability improved by offering information that helps readers judge the “fittingness” of my study context to their own domain.

Table 5.6.1 shows the personality, age, gender, and skill level of the leaders in contrast to that of the rest of the group. Except for skill with Card Board, all answers were taken from the screener. The answer for skill with Card Board is taken from the closing survey.

In all sessions, the participants turned to the study facilitator for instruction, and unless there was a problem with the software or instructions about the interface that needed clarification, the participants were asked to decide for themselves.

According to my observations as the study facilitator, Sessions 1, 2, 3, and 4 had a social dynamic where, throughout the session, one or two players in the game typically took a position of higher authority. Followers deferred to the leaders for instructions on how to play and for advice. Session 1 featured a co-leadership pattern where Players 2 and 3 held this leadership pattern. Also, this was the only situation where one of the leaders was female. Session 3 started with one leader who explained the rules of Hold'em (Dale), but transitioned to a different leader during the Blindman's Bluff exercise (Jeff). Session 7 required me to sit in as a player. Due to my identity as the study facilitator, I could not avoid being seen as the leader in that session.

Sessions 5 and 6 did not have a clear leader emerging from the group. Instead, the group appeared to take the initial instructions from the study and begin playing poker very quickly. These two groups had the highest amount of skill in Texas Hold'em and the small range of skill.

Player & Role					Big 5 Personality (1 to 7)					Skill (1 to 5)			
Session	Pseudonym	Role	Gender	Age	Extraversion	Agreeableness	Conscientiousness	Emotional Stability	Openness	Texas Hold'em	Draw (Poker)	Stud (Poker)	Card Board*
S1	Bob	Colead	M	36	4	5	5	6	6	3	3	2	4
	Sherry	Colead	F	29	7	6	4	6	6	2	0	0	4
	John	Follow	M	24	7	5.5	4.5	4.5	5	1	2	2	4
	Stephanie		F	28	5	5	6	6	5	0	1	0	4
S2	Jeff	Leader during BBB	M	22	4.5	5.5	5	6	6	3	0	0	4
	Dale	Leader during Hold'em	M	26	5.5	5.5	7	5	6.5	5	2	2	4
	Nick	Follow	M	21	2.5	4.5	4.5	4.5	5	2	1	1	4
	Vicky		F	27	4	6.5	5.5	6.5	6	1	2	2	5
S3	Chris	Leader	M	18	4	5	6	6	5.5	4	2	1	5
	Jane	Follow	F	20	4.5	5.5	6	5	7	1	0	0	3
S4	Danny	Leader	M	20	4	5.5	6.5	6.5	6.5	4	2	1	3
	Michelle	Follow	F	28	5	6	6	6.5	5.5	2	2	2	5
	Tara		F	26	3.5	5.5	6.5	5.5	7	2	2	2	5
	Lindsay		F	21	3	6	6	6	5.5	2	1	1	4
S5	Ray	No leader	M	36	1	5	3	6	6	4	4	3	5
	Craig		M	65	3	6.5	6.5	6.5	4	5	5	5	3
	Mike		M	29	3	5.5	6	7	6	3	3	1	5
	Tanya		F	65	6.5	6.5	4	6.5	6	5	4	3	5
S6	Bernard	No leader	M	19	6.5	4.5	6	5.5	6.5	4	4	1	5
	David		M	27	7	5	7	5.5	6	4	4	0	5
	Nathan		M	30	2.5	6	5.5	5.5	5	5	5	5	3
S7	Steve	Follow	M	44	4.5	7	7	7	7	4	5	5	5
	Anne	facilitator	F	27	2.5	5.5	6	6.5	6	2	2	2	5
	Andy		M	37	5	5	4.5	4.5	5.5	3	5	4	5

*Table 5.6.1 Leaders and followers with Demographics, Personality, and Skill. Skill with Card Board is taken from the Closing Survey response for the version that participants used most.*

As the facilitator during these sessions, I offer the following observations regarding personality and leadership.

Leadership appeared to arise when the group had a mix of experts and novices. In these cases, the local expert took on authority as he or she explained the rules of the game. Dale's example shows that this was a temporary position. Transcripts show that he originally talked a lot, explaining the rules of Hold'em to everyone. Eventually, he quieted down. Presumably this is because the players had gotten into a comfortable rhythm of play. When the Blindman's Bluff activity started, another leader emerged, Jeff. He understood the game and directed the group in how to adapt it for play.

Everyone had similar skill levels in Sessions five and six, in which no clear leader emerged. Session 6, chose simple, well-understood variations of poker throughout the entire session. Session 5 opted to play Texas Hold'em for every single game of Dealer's Choice. This style of play may explain why it wasn't necessary to have one person take charge of explaining the rules.

The introduction of unfamiliar games to the group required players to turn to a leader who would explain the game to everyone else. Even people who seemed more reserved during most the session were willing to take on a temporary leadership role. To examples of this were Lindsay from Session 4 and Steve in Session 7. Both were mostly quiet until they found themselves in a position to chose the game to be played. Lindsay chose Spoons and Steve chose Blackjack. Both were comfortable taking a temporary leadership role to introduce their games.

One person refused to pick a game at all. When it was her choice, Anne (Session 7) asked someone else to pick the game. When asked to reflect on this in her closing survey, she wrote,

“I think my lack of knowledge of appropriate games to play on the software, and lower confidence in teaching card games were the reason. In card games I am generally a learner or follower, not a teacher/leader. So having [the facilitator] there as a guide was really important to me knowing what to do. I prefer to learn from people rather than written instructions. It takes me quite a few repetitions of playing a game before the rules stick with me. However, if I had just played a round of something recently in person, I would feel fine transferring that to the board software.”

Interestingly, both Ray and Anne scored very low on Extraversion, a trait associated with leadership (Judge, Bono, & others, 2000). When given the chance, Ray taught everyone the Hold'em variant, Omaha.

What was the difference? Taking into account Anne's comment and Ray's experience in poker games, the difference seems to be that Ray was surrounded by peers of similar skill level while Anne felt like a novice among experts. This likely contributed to her aversion.

In summary, it appears that skill level of the individuals and the groups had a strong influence on leadership of the players. Additionally, Dealer's Choice confers authority to each player in turn. In most cases, players were willing to exercise initiative on their turn and be a temporary leader.

## **5.7 Thematic and Grounded Analysis**

The following is an introduction to the findings from the thematic and grounded analysis of the user study data. These findings provide an in-depth look at themes of rule-changing behavior that arise when players use a flexible system like Card Board. The findings also are especially useful in unpacking the idea of rule-negotiation, an activity that players did not have much to say about in interviews.

My analysis was sensitized according three major categories: Communication, Gameplay, and Rule-Negotiation. To manage the volume of data required to be coded, I chose sub-categories of communication and gameplay on which to focus. By focus, I mean that I actively sought data that reflected these sub-categories, looking for saturation in each sub-category. The other sub-categories remained as sensitizing data<sup>9</sup>, but were not my primary focus.

From the category of communication, I chose three foci:

- a) audio-based communication
- b) visually-based communication
- c) the need that players have to review previously established messages

From the category of gameplay, I chose to focus on evidence of gameplay presence and gameplay readiness. As I progressed, evidence of gameplay adversity, the third category in this theme, emerged from the data.

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<sup>9</sup>By sensitizing data, I mean the background information that will help shape my grounded analysis. (Bowen, 2006)

To understand how players changed the rules to the game, I focused on the broad category of social negotiation of rules. I coded instances where players discussed the rules of the game with each other or made decisions about the rules of the game.

The next three sections encompass the three overarching code categories: rule negotiation, gameplay, and communication. Each sub-category is introduced with a description with illustrative quotations taken from the dataset.

### **5.7.1 Rule Negotiation**

The following codes describe different facets of rule-negotiation. Players adopt different mentalities about rule negotiation. They encounter problems that motivate them to negotiate the rules. They employ a variety of rationales to reason about the rules. There exist patterns of negotiation that can be seen as protocols of negotiation. Lastly, I describe the timing of a negotiation and the scope of a decision.

#### **5.7.1.1 Mentality**

Players expressed personal perspectives about the possibility of changing the rules of a game. I have coded these under “Mentality”.

#### ***Leadership/Initiative***

This is the sense that the absence of full automation requires players to take the lead in defining the game that they are playing.

(Session 3 Group Interview)

**Interviewer:** How about the software? Did that play a role in helping you choose what the rules were?

**Chris:** Not really. 'Cause, I mean it doesn't dictate, like, well ... I guess ... it does recognize when someone hasn't called a bet. So, in that way it does help kind of dictate the rules. But, other than that, it doesn't really say, like you know, when to bet. You have to take

the initiative to start the betting yourself. So, you could hypothetically play without betting at all if you want to.

The requirement of this initiative is that the players must understand the game. Anne appreciated the proper balance of manual and automatic:

(Session 7 Group Interview, discussing the semi-automatic yellow chip)

**Anne:** I guess it was fairly manual, putting the yellow chip in after your turn. I like things that are manual enough that you have to have some understanding going into it. Like, the game isn't just doing it for you. So, I appreciated that.

### *Messing around*

This is a carefree perspective. Here, impropriety, imperfections, and mistakes are allowable. An example of this mentality is when players suggest ridiculous rules. For example, Michelle (Session 4) jokingly offered to play fish, not meaning to actually play the game.

Notably, this prompted Lindsay to realize the degree to which she could play anything for Dealer's Choice. Consequently, on her turn as the dealer, Lindsay picked an unusual choice of game: Spoons<sup>10</sup>.

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<sup>10</sup> Spoons is a fast-paced card game meant to test your ability to split your focus between your own cards and what everyone else is doing. There are spoons in the center of the table, but one short of the number of players. Players hold four cards while passing more cards around in a circle. Each player picks up a card handed to him from the left. If he likes, he can keep the new card and give up one of his four cards, passing it faced down to the right. If any player collects four of a kind, he may grab a spoon from the center. When this happens, the rest of the players should immediately grab a spoon, too. The player who did not grab a spoon is the loser.

(Session 4 Video Transcript)

**Michelle:** anyone wanna play go fish?

**Lindsay:** laughs

**Lindsay:** oh we can play \*any\* card game?

*(Later, during her turn as dealer, Lindsay chooses to play the game Spoons, which is not a poker game)*

*(Session 4 Group Interview)*

**Interviewer:** Why did you choose Spoons?

**Lindsay:** Cause it's a really fun game and I wanted to try something different. When I realized that it's actually just a game board, like a tabletop with cards on it, I was like, "Oh, well, I like playing Spoons and there are items on the board that I can use as spoons." And it's really simple, it's a simple game. Maybe I just wanted to test out how it would feel to play a game that is usually played with speed.

*(Lindsay's choice of game, Spoons, requires some tokens in the center of the board which are typically real spoons. Lindsay plans to use the white chips as virtual spoons to play her game.)*

The interview shows that Lindsay had to come to a realization that any game was possible. The recorded conversation during the game implies that it was Michelle's playful suggestion, her willingness to mess around, that inspired Lindsay.

### ***Pragmatism***

This refers to decision-making that is driven by immediate needs rather than general theory. For example, Danny (Session 4) decided not to play with the small blind/big blind betting system initially because he thought that it would take too much time to explain to the rest of the players.

### ***Idealism***

This is a complementary code to pragmatism. This theme was inferred through selective coding by reasoning that if players have a pragmatic attitude, an opposite mentality competes with it.

Idealism refers to decision-making that is driven by an ideal vision of how a game is to be played. The example with Danny above shows that he was weighing pragmatism against idealism, choosing the quicker route to save time. An example from the data where idealism

holds more sway is where players insist on burning a card between deals. The poker rule for burning a card is to ensure honesty among players. It is meant to prevent players from cheating by adding a secret marking on the back of the next card. In general, the practice of burning a card is treated as a traditional rule by many players such that to forget this step is to invalidate the game. A pragmatic mentality is to let the mistake pass if the dealer forgets to burn a card because it would waste time to bother with correcting the mistake. During the game sessions, players did insist on negotiating and correcting gameplay when someone forgot to burn a card. This tension between pragmatism and idealism can be seen in the following exchange that occurred early in Session 2.

(Nick is the dealer and has burnt a card. Jeff is confused at first about what is going on until he remembers the rule about burning a card)

**Jeff:** Oh! Yeah yeah yeah - ok ..., you have to burn one....

**Nick:** It's always kinda made me -- I mean, it's totally doesn't matter, right? they're all random anyway.

### ***Ownership***

This is the feeling that the rules are in the player's hands. Players had a sense that they could play however they wanted to.

**Chris:** (Session 3) you can kinda do whatever you want to

**Dale:** (Session 2) I liked the natural feeling of being able to play whatever game we wanted if we so chose.

**Steve:** (Session 7) Well, like this way we played whatever game we wanted to where opposed to me go to a list of games you had to pick the specific game and then it's locked to that game.

There are also negative examples of ownership. Early Session 1, when the cards on the board moved in an unexpected way, Bob exclaimed, "Oh my goodness" and lifted his hands away from

the computer. Chris (Session 3) made the same motion when the cards on the board moved unpredictably. My interpretation of this gesture is one of abandoned control, because players are not sure if they did something to perturb the system and give up control over the system to make sure that they are not making a confusing situation worse.

### ***Rule-readiness***

This is the sense that enough of the rule-set has been established or understood to begin playing and that the players can work out the rest of the rules as they play.

In Session 2, Dale asks if everyone else needs further instruction. He contrasts this, not against a complete understanding of the game, but against the idea of being “ready to go”. He moves forward, reasoning that “we’ll just figure it out along the game”:

**Dale:** Ok. So everybody gets ... cards. Alright. So, face down these cards, we can start does anybody else need more of a - more instructions on how to play? or um do we need - or are we ready to go? yeah well let's go with it, if we don't know we'll just figure it out along the game

In Session 1, during the Blindman’s Bluff exercise, Sherry passes out cards to each player even before they have figured out how to see each other’s cards. Bob thinks that that’s a good enough start and that they’ll figure out the next step when they get to it:

**Sherry:** Alright, so I think, maybe we should each get one face down, I suppose?

**Bob:** Yeah, we can start with that. And, well, think about it from there.

To further illustrate the idea of “rule-readiness”, I draw on a real world example. One can look at the instruction set that is included in the card game, Monopoly Deal by Hasbro, which is adapted from of the original board game. There exists a website for clarifying the rules for this game ([monopolydealrules.com](http://monopolydealrules.com), retrieved Oct 2013) that contains a comprehensive listing of the rules. It is filled with details about the rules and corner cases (e.g. “Can you use a Just Say No card

against a Just Say No card?”). The amount of information on this website is far beyond what could be included in the game packaging. What does come with the game is a small insert with two sides. The official instruction leaflet explains how to win, what the game is about, set up, and how to play a turn. The last piece of instruction (Figure 5.7.1.1) shows that the publishers believe that this is enough to be rule-ready and that the players can figure the rest out as they go along.



**START PLAYING AND IT'LL ALL BECOME CLEAR!**

*Figure 5.7.1.1. The final instruction in the Monopoly Deal card game that indicates that players should now be rule-ready.*

### **5.7.1.2 Problem**

Problems in negotiation require players to discuss or clarify the rules. They block the rule-readiness of the group. For example, some players don't know the game; players misunderstand rules; two rules seem to be in conflict; or, a rule needs to be established. (e.g., “Is an Ace high or low?” Chris, Session 4). Outside of the scope of rule negotiation, there are other problems that block the game such as interface problems or mistakes in play. These are not included in this definition for reasons of scope, but they are certainly similar.

### **5.7.1.3 Reasoning**

As players discuss their options, they rely on different reasons for why a particular rule should or should not be established. Part of this category was informed by my study of rule changing in Texas Hold'em and in Halo 2 (Cheung & Huang, 2012) which identifies three types of rule-changing, necessary, optional, and forbidden.

Notable rationales include:

***“That works”***

Players agree that a rule or idea will work in the process of playing. This rationale does not have the same urgency as the idea of ‘necessity’ from my prior work (Cheung & Huang, 2012). In the process of adaptation, players discussed whether or not their idea for passing the cards around would work.

***Precedent***

Players recall rules from having played before and recall how they’d been currently playing all along. After finished their first round, the players in Session 6 had to decide to whom the red dealer chip now goes to. To answer this question, Bernard called on previous experiences to offer two options: let the winner be dealer or pass the dealer chip clockwise. This exchange does not show that past precedent helped them pick between the two options, but it does show that Bernard is using past precedent to offer two legitimate possibilities.

**Bernard:** Oh we – yeah – should we just keep it on whoever wins then?

**Nathan:** Is that right?

**Bernard:** Yeah, sure I've played with just going in clockwise and then I've also played with just keeping who wins in dealer

**Nathan:** Ok, let's just do winners

**David:** Yeah, let's just do that.

Precedent from the current game session was used to convince players to adopt a certain rule and could satisfy questioning players very quickly. In the following two examples illustrate the how quickly a decision can be resolved due to in-game precedent.

(Example 1)

**Bernard:** Do we ante in here or do we just do a round of betting?

**Nathan:** Let’s do ante, we were doing ante before so.

**Bernard:** Alright.

(Example 2)

**David:** Yeah, so how many rounds do we play?

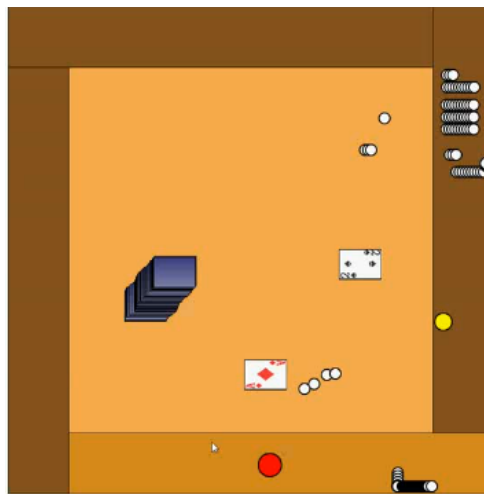
**Nathan:** Um, I think until one person dies – er – runs out? 'Cause that's what we did last time right?

**David:** Yeah.

(Negotiation switches to a different topic)

### ***Fairness and Impartiality***

Players discussed what was fair and, because they stood to benefit from in-game judgments, would express impartiality by removing themselves from the discussion or asserting that they don't care even if they have a stake in the game (see Figure 5.7.1).



**Jane:** so we didn't decide if Aces are high or low... (laughs)

**Chris:** oh.

**Jane:** hahaha

**Chris:** well... I mean.. what... do you want? 'Cause I don't really care.

**Jane:** um...

*Figure 5.7.1 Expressing impartiality regarding a decision: In Session 3, Chris has the ace; Jane, the 2.*

### ***No big reason (related to optional rules)***

I was able to identify rules that players considered optional. This included rules such as playing with in a high-low betting style and choices such as who the starting player should be, who the dealer should be, and in what direction the play should go (clockwise vs. counter-clockwise).

Looking over these instances, I note that the rationale that players used was essentially the lack of one. Players expressed that they did not care or gave little to no supporting reasons to choose one option over another. After players have said that they don't know or care either way, other rationales gained importance to allow players to decide what to do (e.g. precedence or whatever players had been doing all along).

***Negative precedent (related to forbidden rules)***

I identified forbidden rules. For example, Vicky, a novice player in Session 2 offered to show her private cards, but Dale stopped her because they were still "relevant to the hand". In observing the surrounding discussion, I note two rationales within the game sessions.

First is poor past experience. Players try to play a round in a certain way and find out that the experience was bad enough that they say: let's not play that way again. In Session 2, for example, players had a round of betting that had no real limit, even after everyone had matched their bets, the players continued to raise the bet. The players enjoyed the fun of the escalating bets, but when asked to reflect on that betting round during the closing interview, one of the bettors, Nick, stated, "I don't think we'll do that again." The second is "That can't work".

***"That can't work" (related to forbidden rules)***

The second rationale against forbidden rules is when players agree that a rule or idea simply does not work. For example, when discussing the possible ways to play Blindman's Bluff during Session 2, Vicky suggested that the players could promise to close their eyes when showing their card to the others. During the post-game interview, Nick revealed that he had considered that possibility and then rejected it because players were not trustworthy. Vicky agrees that it would not have worked:

**Interviewer:** Did anyone else think of your idea where what is it – you close your eyes or you don't look while other people look at the card that's flipped up? Before you brought it up, was anyone else thinking about it?

**Nick:** I think that it was the thought that was... I feel like it was like a thought like that's an option, but I immediately dismissed it because if this was an online setting where we were just talking over Skype then how would I know if they weren't looking. So, it's kind of like a trust issue. Especially if I don't know the people and even if I do know the people... (laughs)

**Vicky:** Well then I thought of that as soon as I said it. I was like, "Yeah, that's probably not going to work."

### 5.7.1.4 Protocol

Protocols catalogue different activities that constitute rule negotiation. I label them as protocols because their frequency both during and across the sessions suggest these can become routinized.

They offer a concrete description of how the presented themes above are operationalized. It is notable that the mentality of “rule-readiness” is very similar to the code for confirming that everyone understands enough.

#### 1. Asking for a rule in this game

Players ask about what rules the group is playing with in the current session. Consider this example from Session 1 that is prompted by an unexpected moment during Blindman's Bluff when it turns out that both Sherry and Bob have a nine and Stephanie and John have a five. Sherry ask a question that will determine who wins this round:

**Sherry:** Is spades above diamonds or is diamonds above spades?

**Bob:** In [the game named] Hearts...

**Sherry:** In Hearts, it's like, clubs-diamonds-spades -- It's not always the same. (laughs)

**Bob:** Um yeah. I .. I don't know ...we can make it up. Um. I think Hearts... so. yeah.

**Sherry:** Should we go with... Maybe we should have the people that have the fives decide. (Laughs) (Stephanie laughs)

**Bob:** Um, you think in Hearts, it's hearts diamonds spades clu-

**Sherry:** I think it's every other color.

**Bob:** Oh, it alternates.

**Sherry:** Clubs, diamonds, spades, hearts?

**John:** Spades is higher than diamond.

**Bob:** Spades, ok. I think that's ... Let's go with that.

The order of suits that Sherry asks about is known to vary among players. Her question is directed at how the players choose to play in this particular group. This situational awareness is also apparent in the following excerpt from Session 2 where the players pick hearts as the second highest suit instead of diamonds.

**Dale:** Did we just decide on what happens if we tie?

**Nick:** Yeah, uh... spade, hearts, diamonds.

**Dale:** Ok. Cool.

## 2. Asking for permission to do a game action

Players ask if other players will permit them to do an action (sometimes an illegal or unusual one). For example, in Session 4, Vicky accidentally flipped her card up in a public area and asked for permission for a redeal.

**Vicky:** Oh shoot! Oh they're not in my... can you mix me another card?

Despite the fact that Dale had seen her card, the group decides not to redeal.

## 3. Asking for what to do now

Players asked for direction. These are general questions that help the player understand the legality of a move, the purpose of the game, or strategy. They are simple, open-ended questions such as "Ok, so what do you do?" (Session 2, Jeff asks about the next step in Blindman's Bluff).

## 4. Asking if an action is legal

Players would ask if it was legal to make a move. For example, in Session 4, Lindsay asked if she must raise on her turn.

**Lindsay:** Wait I'll just-- can I stay there? or do I have to raise it?

**Danny:** you don't have to raise it -- you can just check

**Lindsay:** Oh ok, I'll just stay there... check.

Conceptually, this category is differentiated from #7 and #8 below in that the code includes include asking about actions that are not about to immediately happen.

## 5. Bending the rules temporarily

Players decided it was okay to bend the rules. These are infractions that are not expected to establish precedent. In Session 4, the players lost track of who owned white chip.

When no one could figure out who it belonged to, Danny just said, "I'll take it!", and he did.

**Tara:** what's this random one in the middle? (Gestures with her cursor)

**Danny:** the red one?

**Michelle:** this? (Gestures at a different chip)

**Tara:** No, there's like a ... a fifth one...

**Danny:** oh maybe it's the one that disappeared. (A reference to a chip that they lost track of) I'll take it.

(Group laughs. Danny takes the chip.)

## 6. Choosing a game

As might be expected, players pick a game to play. The choice of game puts an entire set of rules into play. Players show evidence that they chose games to fit the situation. In Session 5, Ray chose a simple game, five card stud, because he was still familiarizing himself with the software. In Session 4, Tara stuck with Texas Hold'em to avoid having to explain new rules to a group that was already familiar with the game. In the same session, Ray picked five card stud to introduce variety, but also because he wanted a simple game, not too difficult to explain to the novice group he was playing with.

Observed rationales for choosing a game were (a) how comfortable was the group with

the game, (b) how comfortable was the person in teaching the game, (c) what would offer an enjoyable sense of variety, and (d) what did the chooser like to play.

### **7. Confirming that a rule applies – blocking, waiting for confirmation**

(In Session 4, Jane has a turn as the dealer for Texas Hold'em and has dealt the three cards in the Flop, face-down.)

**Jane:** Ok, is that good? Should I flip them?

Players need to know they have properly interpreted the rules as they apply to the next move. In some cases, they cannot proceed further until they have made this confirmation because a misplay might ruin the game.

### **8. Confirming that a rule applies – quickly, expecting a quick answer**

“Is it my turn?” (**Vicky**, Session 2).

“You deal the person to your right first, right?” (**Nick**, Session 2).

“I think I’d be first ‘cause you’re the dealer right?” (**Dale**, Session 2).

“[The yellow chip] should go the dealer next right?” (**Ray**, Session 5)

“I’m going to try NOT to go over twenty one?” (**Anne**, Session 7)

Players ask about a rule, expecting a quick answer. Some are already in the midst of making a game move as they ask their question.

### **9. Confirming that everyone understands enough of the rules to move forward**

In a game where the players are responsible for enacting the rules of the game, it is essential that they understand it. As Steve (Session 7) reflected in the group interview, “You just gotta know the rules of the game and how to play. You really gotta know know what game you’re playing to actually know how to deal the cards, know how to play the rounds and how the bidding goes.” Thus, the players need to make sure that everyone understand enough to move forward. This confirmation is reflected in the following exchange during Session 4:

**Lindsay:** alright? Are you guys ready?

**Mike:** yeah.

**Lindsay:** Do you have any other questions?

**Michelle:** I don't think so.

**Tara:** ok.

## 10. Correcting a wrong move (or “undo”)

Players correct each other if they think that the other player has incorrectly interpreted the rules. In Session 2, Jeff stopped Dale in the middle of a dealing action as soon he thought that the game was going awry:

**Jeff:** Oh no no no no. It... it's – no. You only -- you just take one card face up. You don't – you don't put another facedown card.

(Although, in this case, when Dale responded to Jeff, they found that it was Jeff who was in the wrong about his interpretation of the rules.)

## 11. Imperative command

Players tell others what to do with a command. This example in Session 4 shows a decision that Danny makes quickly, without prolonged negotiation, and orders the rest of the players to follow. This excerpt is taken from a game where Danny is clearly the expert. Lindsay did not know what antes or blinds were, so Danny made an executive decision and proceeded to tell the other players what to do.

**Danny:** So do you guys want to do blinds or antes?

**Lindsay:** I don't know what those are.

**Danny:** Ok, let's do antes then, that's easier. Everyone should put in -- I don't know -- one dollar. And that's your initial bet before the cards are flipped

**Michelle:** ok.

## 12. Instruction

A player tells other players what to do, in accordance with the rules of the game.

Instruction can become quite involved, taking time and communicative effort, in Session 4, when Lindsay teaches everyone how to play Spoons, there are long segments of time where she is speaking and the game board is has no activity; even the players cursors are relatively still.

## 13. Reminding everyone about a rule

Players remind each other of rules. In Session 3, Jane forgot the next stage of Hold'em which is to reveal one more card, the "River."

**Jane:** mmmh.

**Chris:** you flip, uh, one more card.

**Jane:** Oh, right.

## 14. Reviewing official or traditional rules

Players ask to review the official rules of a game of a variant. In session 5, Ray's choice as the dealer was to play Omaha, a variant of Texas Hold'em. The other players knew of the game, but asked for a reminder of the commonly accepted rules for this variant.

**Ray:** Has everyone played Omaha?

**Mike:** remind me of that one again?

**Tanya:** yeah. refresh my memory

**Craig:** is high low?

**Ray:** no it's uh -- well, I think it's like the-- you get four -- you have to use two of your four and then you use three from the

**Mike:** oh ok.

**Tanya:** it's just high only?

**Ray:** yeah, high only (t4: "ok")

**Craig:** high only.

**Ray:** yeah, the high low gets too complicated (continued next page)

**Tanya:** yeah.. heh.

**Craig:** is there an ante?

**Ray:** yeah, it's the blinds like Texas.

**Craig:** oh it is -- ok.

The source of rules can come from the players memories, but also was observed to come from external information sources. For example, Stephanie took out her mobile phone and looked up the rules of Texas Hold'em on Wikipedia during Session 1.

Another source of rules was Card Board itself. Players decided who was to be the first to play because the red chip was in a player's area in the start. The players in Session 6 were originally playing in counter-clockwise order, but switched when they tried the semi-automated version because the automated yellow chip moved in that direction.

### **15. Setting a rule**

A rule is adopted. For example, during Session 4, Danny establishes a location for discarded cards. (**Danny:** Let's put a discard right there... hiding under these chips.)

### **16. Speculating about a rule ("Maybe"; "If")**

Players discuss the implications of applying a rule. In Session 1, Sherry speculates about how to organize the bets.

**Sherry:** Alright, should we move these chips into the center now?

**Bob:** um

**Sherry:** Maybe if we put them all in here, we can highlight them all and stack them.

(**Stephanie:** oh ok) Put your own chips in the... middle

**Bob:** Yeah, if we put them all nearby each other, it should be easy to stack

### **17. Suggesting a rule**

Players introduce a possible rule for adoption. Here is an example from Session 2:

**Dale:** Any suggestions from the group for the size of the ante?

**Nick:** Well, we could always just start one with for the first game

**Dale:** Sounds good to me

### **18. Unfinished negotiation about a rule**

This is a negative example of a rule negotiation protocol where a player(s) start talking about a rule, but no decision is made. This theme is inferred via selective coding as an opposite of a finished negotiation process. Additional evidence of this code comes from my observation of an instance where Danny in Session 3 turned to ask me, as the facilitator, a question about the rules for betting. When I refused to answer, he dropped the question, but did not ask the players what they thought. Although this instance was not naturalistic, it directed my attention to the idea that negotiations can be interrupted or incomplete.

Thus, I include this code in the codebook due to logical inference and the presence of the observed interaction with Danny.

### **19. Unspoken suggestion for a rule**

This is a negative example where players hold back from suggesting a rule. In a previous example, I described how the players in Session 2 considered then rejected the idea of having players close their eyes to show their card to other players in Blindman's Bluff. It was deemed untenable because of trust issues. In the closing interview, Nick confessed that he thought of the rule, then immediately dismissed it without speaking up.

### ***Timing***

An aspect of each protocol to highlight is that of time. There is a spectrum of times when players discussed rules. Players would discuss a rule long before it is applied, immediately before a move, or after a play has already been enacted. I develop this concept further in the discussion with a rough diagram of the role of timing in rule negotiation.

### ***Scope***

A second aspect of each protocol is scope. The impact of a decision can be considered temporary or permanent. Or, even as a precedent for future games. Rereading the examples above, one can see that some decisions have almost no expected impact on scope (e.g. rule-bending) and other decisions are expected to apply for the rest of the game (e.g. the discussion of suit order).

## **5.7.2 Gameplay**

The following codes encompass my findings for the categories of gameplay dimension. These findings provide a picture of how gameplay looks over a digital flexible game system. Also, they show the value of these dimensions as an analytic tool for understanding game play.

Under gameplay presence, I describe how players engage with a flexible system in meeting their particular gameplay purpose, progressing forward in the game, and engaging in information tasks about the game state. Under gameplay readiness, I describe the breakdowns that players encounter and their response in fixing activities and preemptive action to protect against breakdowns. Also under gameplay readiness, I discuss the importance of skill and touch on competing non-gameplay foci that interfere with the players' ability to focus on the game. Under the category of adversity, I present two subcategories of interface adversity and game adversity.

### 5.7.2.1 Gameplay Presence

By considering the game as the central task of the players, I have analyzed the game sessions and interviews by looking for evidence that players are attending to the main task of winning the game. The following sub-categories emerged from the coding process: game goal, game progression, and game information. In addition to shedding light on how games are played over a digital flexible environment, they also highlight three major subcategories of understanding Gameplay Presence.

#### ***Game Goal***

The game goal can be seen as the point of the game. It depends on what the players expect the game to be about or what its central mechanic should be. This concept is akin to the concept of game genre (Apperley, 2006). In fact, Parlett's list of game genres for card games (Parlett, 2008) is a highly informative starting point for anticipating what the central mechanic of a game is. I have not named this category as "genre" because my focus is on the uniqueness of one game instance with one set of players in a particular point in time. As I analyzed the data, I found that the primary purpose of the game varies among groups of players and between the games that they play. One interchange during an interview with the participants in Session 4 illustrates how each game is unique and how that changes the players' expectations of the software. During Dealer's Choice, the players were led into a game of Spoons<sup>11</sup> by Lindsay (Session 4). After losing the game, Tara, who had never played Spoons before, reported that she would have preferred to play the game with real cards.

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<sup>11</sup> See the prior footnote in Section 5.7.1.1 for a description of Spoons.

**Tara:** I think a real life game of Spoons, you'd be able to see how other people are moving around faster and just like other people throwing cards at you physically. If you can sense how fast other people are moving I might see that, but I was sort of staring at my own little box not really paying attention to how the other cards were moving around.

**Lindsay:** I think that's a good simulation of how it actually is played in real life though. 'Cause the reason why things are in the middle are 'cause you're so focused on getting the next card and figuring out if that's the card you want and like you're usually so in your own zone actually, that's why you can either play Spoons where someone obviously takes a spoon, or as discrete as possible.

This interchange highlights how the game goal for Spoons is different than some other games and perhaps differently anticipated by its players. Tara would prefer a different experience of Spoons than Lindsay and looks towards a different medium. To comment on the interaction between the software medium and the game goal, consider how, in this game of Spoons, a limiting factor of Card Board (the ability to scan the game board and understand the game state) is desirable. It is a difficulty inherent in the medium that is meant to be engaged by the players during the game. Here, the limitation of Card Board, as characterized by Lindsay, actually contributes to the goal of the Spoons game. Using my game dimension vocabulary, one would say that this is a desirable type of game system adversity.

The variety of game goals appears to be a good fit with Card Board in that I saw evidence of satisfaction and fun for players with different preferences from novice to skilled poker players and different choices of games.

### ***Game Progression (State to State and Stage to Stage)***

Certainly, participants progressed through the game. This means that they engaged in actions that advanced the state of the game towards its resolution, moving from state to state. Some games have well-labeled states which I label “Stages”, for example the formal stages of Texas Hold'em

are the deal, the Flop, the Turn, the River, and the Showdown. Players performed the motions that each game stage might require (bidding, dealing, etc...). The progression of game state from start to finish is the main activity of gameplay; and, its centrality is the reason that it is categorized under Gameplay Presence. Other kinds of activities, like learning how to play, are considered a distraction. This is illustrated in the following quote:

*“I mean I think part of the time was taken up learning. I mean like we had some familiarity with [Card Board] before, but not interactive with the others. And so, I think you know, once ... once I got familiar with it, I was like ... it was a lot easier to concentrate on what was going on rather than just ‘how do I use this?’” – Vicky (Session 2)*

Because Card Board emphasizes manual play and sacrifices automatic functionality, I observed players communicating their actions to progress in the game. Examples of this include the way that they place bets or check verbally and how they end the game. For example, players cannot use the automatic system to determine who has won. Instead, they declare aloud over the Skype audio channel who has the better hand and has, therefore, won the game.

### ***Game Information***

The last sub-category is information about the game state. The game is in a certain state (it is a certain player’s turn, the game is over, the game has started, etc...). Players seek to identify the game state and declare it to one another. They signaled to the other players that they were ready for the next stage of the game. Also, players asked each other if they were ready for the next stage (e.g., to be dealt a card or to start the next player’s turn). (e.g., *“OK, everybody has looked at their cards right? (group affirms) OK since I'm the dealer, the betting starts.” – Craig, Session 5*). It may seem that being ready to start the next stage is related to gameplay readiness rather than gameplay presence, but a key difference is that there is no breakdown to solve in this situation. The game is progressing as intended.

In addition to taking in information, players sought to act in ways that other players could observe. For example, Chris shared about how difficult this was for him when betting.

(Session 3, Group Interview)

**Chris:** The only part where I had trouble was, um, I guess, visually showing how many chips I was betting.

**Interviewer:** Ok, visually showing -- oh, so then, you felt like you weren't sure the other person knew how much --

**Chris:** Yeah, because I would drag a certain amount at once instead of doing it individually like she did.

Lastly, players valued getting information from the system in an unobtrusive way. Sherry

(Session 1) had this to say about the Game Log that appears on the side of the game screen:

**Sherry:** Yeah, you mean as far as like, the words that were going on the side of the screen and stuff like that? Well, that was useful, too. 'Cause, I mean, that's kind of on the side so it's not stopping you from playing. But, um, then you can kind of catch it if something's going wrong like... I think the thing we did the most was like putting in the wrong number of chips to the middle. So then it would tell you when the chips were not in the right place. And you could sort it out.

### **5.7.2.2 Gameplay Readiness**

Gameplay readiness describes how Card Board serves as an unproblematic tool as players attend to the game that they are playing. Described below are the sub-categories of breakdowns, fixes, protections, skills, and non-gameplay foci.

#### ***Breakdowns***

Prominent as a sub-category was the evidence of breakdowns. Breakdowns show how the players' attention breaks away from the game. Players' attention was directed to an issue that kept them from attending to the game in the way that they desired. I identified breakdowns in the data by the way that the game experience was interrupted, in the way that players diverted their

attention from the game, and in the way that players would troubleshoot the game interface or the agreed upon rules.

Breakdowns have different levels of severity as shown by the reactions that players have and the kinds of fixes that players rely on. Some can be ignored or dismissed; others require a complete restart of the game. Breakdowns are not universally defined across different games and players.

Observed cases include:

- A. The automatic game system misinterprets the game state. Just as I described in the descriptive scenarios in my introduction to Design 2, players would play in a way that would derail the logic of the yellow chip. For example, in Session 5, players preferred to have the bets for the big and small blinds already on the table before the initial betting started. Because of this preference, they expected the yellow chip to already understand that the blinds had been bet and that the yellow chip should automatically move to the third player. This was not the case and for the first few times it happened, the players commented on the mistake. Eventually, they became accustomed to the behavior, but it still annoyed them.
- B. An incorrect play by the players. Simply put, if a player played incorrectly (e.g. betting too little), the players stopped playing and wanted to fix the error (if possible).
- C. Players misunderstand the rules. Similar to the breakdown above, this breakdown is a result of players misunderstanding the rules. This can result in an incorrect play as above or simply in an interruption in the game as players ask about the rules and correct each other's misunderstanding.

- D. Players mishandle the software. Players would click on the wrong item, move something unintentionally, or both try to move the same card at the same time creating a race condition within the Card Board. These problems redirected the players' attention to the user interface.
- E. Players become impatient while waiting for other players to respond. This echoes the issues of pacing mentioned in Section 2.2.
- F. Players become impatient while waiting for the system. For example, in the semi-automated version, if two or three players check (bets nothing extra), each player must drag the yellow chip into the center and wait for it to automatically move to the next player. This is almost instantaneous in the manual version of Card Board because the players would ignore the yellow chip and just say the word "Check" in rapid-fire succession. In the semi-automated version, the additional cost in time feels tedious and shifts the players attention away from the game and into a critical view of the medium.

Note that this sense of tediousness may arise over time. The feature for shuffling is animated. Cards fly in one at a time into a shuffle stack. This display of cards being shuffled was initially novel to Jeff during Session 2, on his first experience, he exclaimed, "Cool!" Later, when the novelty had passed, the shuffle animation became tedious to him.

### ***Fixes***

The accompanying category to breakdowns is that of "fixes". These are actions that players took to overcome a breakdown. There are major fixes that are highly disruptive such as having to abandon the entire game and restart again. There are minor fixes. A card that is accidentally

flipped up might be “burnt” (a poker term for removing a card from play). Burning the card is minor because it allows players to continue play with minimal disruption.

There is also the absence of a fix, players do not do anything special, they just move on with the game. During Session 3, due to a bug, the Game Log repeated the bid amount twice. The players noticed, but did nothing.

**Jane:** Why did it say your bid was two dollars three times?

**Chris:** Uh, I don't know.

**Jane:** Mmm. Okay. Okay, now what?

**Chris:** now we drag our cards into the...

**Jane:** ok into the thingy.

Who does the fixes? Data suggests that fixes are social. Not only does a fix have to be accepted by the players, but also players ask for help from others and work together to fix a problem. In many instances, players would all reach forward to help shuffle, arrange cards, and make small adjustments. For example, the Community Zone would only react to cards that were placed completely within it. Any cards that were intersecting its boundary were ignored. This was a problem for players who accidentally dropped a card just a few pixels off. In Session 5, Ray helped Mike who has just encountered this problem.

**Ray:** I think this one needs to be moved over

**Mike:** oh thank you. It's a very small box.

### ***Protection/Preparation***

Fixes happen after a breakdown. Analysis shows players also took *pre-emptive* action to prevent breakdowns. These I categorized as “Protection/Preparation”. Players were observed to take actions to protect against potential breakdowns by arranging the layout for less visual clutter and moving loose cards (e.g., making and identifying a discard pile) to have less chance for mistakes.

One kind of protection is to implement a rule that will minimize the odds of a mistake. In Session 2, Jeff continued to optimize the way that the group played Blindman's Bluff. One rule that he implemented was to have each player take extra actions to ensure that no one would accidentally see a card. He established that cards had to be flipped down before passing to the next person. This was a protective action that Jeff took to avoid the breakdown of seeing someone's private card.

### ***Skills***

To keep the players in the flow of the game, a set of skills is required. This category is informed by the theory of flow (Csíkszentmihályi, 1991) in which skills are the basis for an ideal, enjoyable experience of an activity. Required skills that I observed include expertise in using the system and knowledge about the game rules. An illustration of the skill needed for system expertise can be seen in the skillset required to arrange chips on the board. Players across all of the sessions took time to arrange their chips in aesthetically pleasing patterns. Some players could not figure out how to recreate some of the neatness that others achieved. Sessions 4 (Lindsay) and 6 (Nathan) both contained entire conversations among players where one player stopped the game play to ask everyone how they were able to stack their chips as nicely as they had. Players tried to explain how to do this, although neither Lindsay nor Nathan were able to figure out the trick to it which frustrated both of them.

I observed skills that appear to be relevant to the use of a semi-automatic game system. Because the Game Log or yellow chip in the semi-automatic version could become derailed, players needed the skills to decipher how Card Board kept track of the cards and chips and what was wrong when automatic derailment breakdown occurred. Also, as prior quotes have mentioned, players needed to know the game to a higher degree than purely automated systems to be able to

play. One example of this is knowledge about the game vocabulary: what is a Flop? A Turn? A River? The novice players in Session 4 struggled with the vocabulary and started with their own words, “meet it” and “see it” instead of “calling” and then confusion between “check” and “call”. This shows both how fluid the game vocabulary can be in a flexible environment and also the higher requirement for grasping the rules to play in a manual environment.

### ***Non-gameplay Foci***

The focus of gameplay is the play of the game. Competing foci are similar to breakdowns but not as critical. Like breakdowns, they can distract from the main focus of a game activity, however, they are not necessarily undesirable. An example is the following playful distraction from the game at hand. In Session 4, Danny left his mouse cursor hovering over Michelle’s chips. In response she shooed him away:

**Michelle:** Ahem.  
**Michelle:** Get yer cursor off my cards!  
**Danny:** hmmm?  
**Lindsay:** (chuckle)  
**Danny:** oh, sorry  
**Tara:** laughs  
**Michelle:** a little virtual bubble please.

From this point on, the group continues to tease each other. During the interview, Michelle pointed out that she appreciated this distraction from the game: “Related to cursors and seeing that - it was nice. I like how there was a playful element on top of this with the cursors and chatting about random things.”

My analysis revealed the following non-gameplay foci:

- A. Demonstrating a game or play
- B. Making the chips look neat
- C. Playfulness (joking, laughter, etc...)
- D. Reflection (talking about the game after it is over)
- E. Strategic Advice
- F. Teaching about the interface or about the game

I close this section with observations about how players felt about Card Board and learning the game. Teaching and learning are non-game foci that ultimately contribute to a better game experience because players are acquiring the skill to enjoy a game or to understand a potential rule change. Both the manual and semi-automatic versions contribute to this task, each different ways.

On one hand, players liked how the manual aspect of the game required them to get a deep understanding of the rules of the game. Also, as explained by Tara and Danny in the closing interview, support for freeform activities made it easier to teach many games and to play around or “fake” a scenario.

(Closing Interview, Session 4)

**Tara:** I think, if, I or someone else were trying to explain poker or certain different versions of this game to someone far away this would be a great tool for explaining all the different varieties and going through that.

**Danny:** Yeah you can play around, fake stuff if you wanted.

Anne from Session 7 said that she preferred having a person talk her through a game in contrast to digital text. “For me as a learner, hearing other people, like verbally explain things is effective. And, I can catch on to that, but if a screen is telling me how to play, I just am not as apt to read

that or be excited about playing..” Yet, she also liked the procedural elements in the semi-automatic version of Card Board:

(Beth, Session 7 Closing Survey)

Yellow Chip, shuffle, selection/collection of cards/chips, the bet tracker and community cards zone were helpful to me. They facilitate a learner playing the game without confusion/feeling overwhelmed by things to remember. Everything you need to keep track of is out on the board in writing.

### **5.7.2.3 Adversity**

Gameplay adversity was not initially coded for, but the codes for breakdowns as well as the questions in the interviews that discussed difficulties in the interface prompted me to identify instances in the data as “Adversity”. It, unlike breakdowns, is not necessarily a negative aspect of the game experience. Two kinds of adversity emerged Interface Adversity and Game Adversity:

#### ***Interface Adversity***

For the interface, the following adjectives were recorded: “Convenient”, “Easy to manipulate”, “Difficult”, “Intuitive”, “Fast”/ “Slow”, “Tedious” / “Cumbersome” / “Unwieldy”. The participants’ feedback naturally gravitated towards the details of the interface. Commonly reported by players was feedback about the response time, how easy it was to distinguish between card symbols, and requests for small automatic features like dealing. As mentioned before, the adverse aspects of the software were sometimes frustrating, but also, sometimes desirable as is the case of Spoons.

#### ***Game Adversity***

For the game, players often discussed their choice of game as simple or easy to play.

The relationship between adversity and rule negotiation is that many players weighed the cost of introducing a new game against the cost of teaching the game to new players. As a result, players chose to play simple games such as Five Card Stud, Five Card Draw, or Black jack and simple variants such as Omaha Poker. This phenomenon occurred both in groups with expert and novice players.

### **5.7.3 Communication**

Regarding how players communicated, I picked three dimensions to focus my analytic attention: Audio, Visual, and Review.

#### **5.7.3.1 Audibility**

Audio communication facilitates play and negotiation of the rules of the game. Playing the game was not only composed of player actions (moving cards, etc...) but also of speech (“uh...ok. I’m gonna fold.” – Chris, Session 3) To facilitate a game, players used Skype to identify each other, ask about the game state (“Are we still bidding?” – Jane, Session 3), to describe moves on the board (“I was going after the yellow circle...” – Tara, Session 4), and to explain what they were seeing on their own screen (“Hand on my card’s moving... ok.” Lindsay, Session 4).

#### **5.7.3.2 Visual Gestures**

Visual channels were observed as gestures made with the mouse cursor. Nick (Session 2) drew circles with his mouse cursor around Vicky’s chips until she remembered to fix her bet. Others used the cursor to point at elements on the board and verbally ask them to move a card.

#### **5.7.3.3 Reviewability**

The dimension of reviewability refers to the times when players want to review past communicative messages. I chose to analyze this aspect of Card Board because I anticipated that

players would want reminders about the rules of the game and would want to review the history of moves in a game.

Data about using the software features to review past messages was not mentioned very much by the participants, at least not directly. This was difficult to analyze because the act of reviewing, when successful, meant that players did not speak up. For example, if a player forgot how many cards are normally flipped over during a Turn, they may have looked at the cards on the table, seen the fourth card on the board, and, thus, answered their question. They are using the reviewability in the physical layout of the cards on the table, but they would not normally speak up when they get the answer.

Despite these challenges, I found evidence of four types of reviewing activity. This informs the reviewability of the medium. First, players verbally reminded each other of the rules of the game. Second, the game log system gave players a history of actions to “track” what had happened (as reported by Stephanie, Session 1). Third, players relied on the layout of the pieces on the board to determine what had happened: Craig (Session 5) claimed to ignore the yellow chip. When asked how he played instead, he said that he looked at the bets to grasp the game state: “I mean, I just know what turn it was because of the white chips.” In session 6, Nathan decided to take a bathroom break. He had just folded his cards and was out of the round. He reasoned that it wasn’t a big deal to go to the bathroom and, on his return, he depended on the state of board to see what had transpired.

**Nathan:** I noticed, like, almost all the chips were out there, so I was kinda curious, too.

Fourth, players depended on traces of animations of game pieces as they moved across the board to register changes to the game state that they had not originally been paying attention to.

Stephanie (Session 1) reported, “The motions had a little lag when you drag something, but actually, it's good because you can see the track, kind of?” As mentioned in previous sections, Chris (Session 3) wanted to move his chips in the same piece by piece way that his opponent did because he reasoned that the animation would allow Jane to see what he had done.

Common across these activities for supporting reviewability is input and output – or, perhaps in other words, recording and retrieval. Players act in ways to deliberately record a message and other players seek to retrieve that message. Stephanie reported that she appreciated the Game Log as a source of record for her to track the game progression. Making a verbal “record” is as simple as explaining the rules of the game. Moving chips can be a form of recording the rules. When Danny (Session 4) created a discard pile, he placed a chip over it as a reminder.

As anticipated, the freeform nature of Card Board facilitates this recording and retrieving messages. Certainly, more can be explored about the relationship between more structured logs such as the Game Log and unstructured ones such as an informal arrangement of cards on a table.

#### **5.7.3.4 Game moves as Communicative Acts**

Arising from the data, a fourth sub-category of communication that surfaced was the use of a game move as a form of communication, matching similar findings from Game studies (Tang, Massey, Wong, Reilly, & Edwards, 2012). For example, to raise a bet on a player can be seen

as challenging action or even an insult. Tanya (Session 5), in response to a raised bet, exclaimed, “Stop it, [Craig]! That’s not nice!”.

Two types of communicative game moves featured prominently across all of the sessions. First, players moved the red Dealer chip to signify who the new dealer was. Second, the players moved the yellow chip to signify whose turn it was. Predominately, this behavior occurred with the automatic system that required the players to move the chips, but the same behavior did occur on occasion in Design 1 where there was no such requirement. In both cases, players were observed to depend on the location of the chip to understand what was going on. The passing of the Dealer chip had a communicative intent, signaling that a player was now assigned the role of dealer for this round. The yellow chip was a signifier (it’s your turn); also, players used it to identify each other, too. (e.g., “the person with yellow chip should put in one” – Jeff, Session 2)

### **5.7.3.5 Analyzing Co-occurrences of Communicative Modes and Rule**

#### **Negotiation Protocols**

Since rule-negotiating instances in the video-recorded sessions had overlapping codes with the above communicative modes, I was able to look for co-occurrences of the two. What follows are associations between mode and protocol that are reflected in the data, seen multiple times and across sessions.

The modes mentioned in this section are:

- *Audio Only* – Only audio is used to negotiate the rules. Often players’ mouse cursors are completely still while a conversation ensues. Players reported that audio was critical for Card Board: “Being able to talk was critical. Because the board is not constrained we had

to communicate quite a bit to keep the game moving correctly.” – Sherry (Session 1, Closing Survey)

- *Audio + Visual Gestures* – Audio exchanges are supplemented by gesturing.
- *Audio + Game Moves* – The audio is tightly intertwined with game action in progress.

My analytic method was not an exhaustive catalogue of every communicative utterance. Because of this, only the co-occurrences for Audio communication existed in large enough numbers to merit a closer look. No instances of rule-negotiation were found without the use of audio. Although it is likely that the preferred communicative method is Audio, this may also be questioned because of the potential bias towards audio data in my method of analysis. (See the study limitations for my explanation.) Aside from commenting on the primacy of audio, I am able to offer a better understanding of how audio communication works alongside rule-negotiation.

Five categories employed Audio Only communication:

1. Asking for what to do now
2. Choosing a game
3. Confirming that everyone understands enough of the rules to move forward
4. Confirming that a rule applies, quickly, expecting a quick answer
5. Reviewing official or traditional rules

The following employed Audio Only heavily, but with occasional instances of the other modes.

1. Asking for a rule in this game (*also instances with Audio + Game Moves*)
2. Setting a rule (*also instances with Audio + Visual Gestures; Audio + Game Moves*)

The cognitive theory that inspires these communicative dimensions (Clark & Brennan, 1991) offers an explanation for the well-suited-ness of audio to these activities. Clark and Brennan describe the principle of least collaborative effort as the minimal effort that speakers perceive it to take for them to come to a collaborative understanding. This might explain why audio is a well-suited choice for protocols that are time-sensitive such as the need to quickly confirm a rule or asking for instruction.

#### **5.7.4 Summary**

In summary, my qualitative coding derived the following:

For rule negotiating that occurs during a game:

- A. A number of prominent mentalities including Leadership/initiative, Messing around, Pragmatism, Ownership, and Rule-ready (my term for a sense of readiness to play that depends on understanding of the rule-set)
- B. Problems that require negotiation
- C. Reasoning that is employed during negotiation. Notably: Fairness/Impartiality, “That works”, and Precedent
- D. A list of different protocols for negotiating rules each with their own kind of timing with respect to game action (sometimes before, sometimes after an action has occurred) and scope

The Gameplay Dimensions were particularly fruitful for categorizing play. In general, these sub-categories of goal, progression, and information are promising in how to understand the

gameplay presence for any game. Specifically for understanding flexibility, these categories show the diversity of requirements that can be imposed on a game's goals. Also, because of the manual nature of Card Board, players progressed forward in the game by relying heavily on communicative strategies, verbal announcements about their bets and moves. Lastly, the information needs seemed especially high – and, players preferred that the sources of information remained unobtrusive.

The category of Gameplay Readiness was rich with examples of how players worked together in a manual system to overcome breakdowns and to protect against them. Within these efforts to allow the group to play unimpeded, the pursuit of gameplay readiness included some “satisficing” solutions such as ignoring potential minor breakdowns or dismissing the consequences, “whatever”. Gameplay Adversity resurfaced as a useful dimension for discussing the difficulties in a game or in manipulating the interface; these difficulties could be desirable or not in different circumstances (as seen by the different gameplay Goals that exist). A relationship exists among game adversity and rule negotiation where players choose simple rules and games to make it easier to play and negotiate.

Three communicative modes were analyzed: Audio, Video/Gesture, and Game move.

“Reviewability”, was also examined by looking at how players reviewed the game state and established game rules. All of these were employed for the negotiation of game rules. Players were seen to have deliberately sought to communicate their actions through their game moves (e.g. wanting their decision to bet to be visibly seen by their opponent). I interpret this to mean that players can be quite deliberate in how they insert audio, text, and game-motions into a historic record for other players to retrieve. I analyzed co-occurrences of communicative modes

and rule negotiation protocols, finding that audio was a highly preferred channel of communication. Findings suggest that audio is well-suited for situations that are time-sensitive such as a quick confirmation of a rule.

## **5.8 Themes of Rule Negotiation**

The codes presented above, in themselves, offer a richer understanding of rule negotiation, gameplay, and communications in flexible game systems. Additionally, they can be drawn together to paint larger themes about rule negotiation that I will now present. There are three major themes. The first theme is an assertion that rule negotiation can be rather mundane rather than creative. The second theme recognizes a common thread that intersects multiple aspects of play which is the concept of “readiness”. The third is a presentation of a model of live-tweaking which maps negotiating protocols on a graph that accounts for timing and scope. These themes will close this chapter on the user study by setting the stage for answering my starting research questions in my concluding chapter.

### **5.8.1 Mundanity**

Negotiating the rules is not just a creative outlet. By this, I mean that it is not an activity restrained to exceptional players who want to reinvent games. Instead, my findings point towards a picture of rule-changing as plain and mundane. It is articulation work (Schmidt & Bannon, 1992); it is part of the work it takes to make play possible.

Certainly, in many cases, the goal of a player can be creativity in itself. The highly innovative creations from Minecraft and modifications of commercial games by enthusiasts (Kücklich, 2005) are inspiring exhibitions of creative play. However, such creativity is not always the game goal. None of the game goals exhibited in the user study was to showcase the players creativity, they were to have fun, to bluff, or to be quick. To accomplish such goals, the players tailored

their experience to meet that goal. The actions displayed by players (as they fixed breakdowns, prepared against breakdowns, instructed, negotiated, reviewed and confirmed rules) are more in line with a pragmatic perspective rather than rule-changing for the sake of creativity.

This is also a reminder of Crabtree et al.'s assertion that there is work in play (Crabtree et al., 2004). In this case, it is work that is done by the players themselves to foster and protect the game that they prefer.

Flexibility is mundane, and yet, relevant to the design of game systems that players prefer. Players reported that they felt that they were actually playing a real game of Hold'em (Ray, Session 5). Sherry (Session 1) stated that Card Board was ideal for supporting the social interaction that she did not see in her existing online games. By recognizing the practicality of rule-negotiating, we also recognize its generalizability across a broad number of play situations.

### **5.8.2 Levels of Readiness and the Satisficing Imperative**

The idea of readiness intersects multiple categories from the user study. There are three tiers: ready for the next stage of a game, ready to focus on the game, and enough knowledge about the rules to play. These are ordered loosely by what is needed to be able to play. A player needs to know the rules first, to be able to focus second, and then is finished with his turn and ready for the next stage of play. This is a loose because I will show that in digital games this order is sometimes mixed up.

#### **5.8.2.1 Next-Stage Ready**

During a game, players want to know when the rest of the group is ready for the next stage of the game. In the formal turn-taking of card games, this boils down to "ready for your turn?" and "ready for the deal/bid/showdown". A future research question will be to see if this kind of

stage-readiness is sought by players in real-time action games or games with less strongly delineated stages.

### **5.8.2.2 Gameplay Ready**

For the successful experience of a game, the entire category of gameplay readiness is one that players are aware of and actively promote, support, and defend. This is especially notable in the amount of articulation work that the players engage in to avoid breakdowns and to fix them when they do occur.

### **5.8.2.3 Rule-Ready**

A key element of gameplay readiness is rule-readiness. This is the condition in which players know enough of the rules to start playing. This doesn't mean that players need to know the rulebook back to front. Instead, often the group just wants to know enough to play, believing that they can "work it out" over time. This can also be seen in how quickly the use of precedent will convince players to accept a decision about a rule.

Rule-readiness is a key concept in a game situation where the players are experiencing a game for the first time. It applies even in a fully-automated situation. Interviewees from Session 1 discussed how the learning experience for card games is a bit bewildering because the vocabulary is almost meaningless to them. They jump into a digital game where there are three buttons to click ("Fold", "Raise", "Check") and are left to their own devices in interpreting the meaning of these phrases. These automatic systems actually offer players a strange position. They are not rule-ready, but they are already playing according to the rules of the system.

#### **5.8.2.4 The satisficing imperative**

At the core of this theme is an undercurrent of satisficing. Once players are ready on any of these levels, there is no reason to keep from moving forward. It is as if there is a signal that everyone is waiting for. Ready players understand the rules, or are skilled enough to play, or have completed their turn early. They are forced to wait for an unready peer or an unready system (such as the shuffle animation) to catch up. This imposition is increasingly undesirable as players improve.

This finding corresponds with my earlier review of digital and analog games which noted that online games are very fast paced and even digital conversions of analog games (Wallace et al., 2012) suffer from similar speed ups (even to the detriment of the players' ability to stay aware of what is going on in the game).

This also explains why the players in my user sessions often compromised perfection for the sake of moving forward in the game. They accepted flaws in the interface and mistakes by other players for the sake of continuing the game.

Before transferring this theory to other domains, I add a word of caution. The participant-pool for this study was selected for above-average personality traits for agreeableness which is correlated with forgiveness in games (Li & Chen, 2012). This would suggest that the ways that players overcome blockers to readiness will depend on the circumstance and on the preferences of the players.

#### **5.8.3 A model of live-tweaking: recognizing timing and scope**

From the findings, it is possible to create a rough model of how rules can be negotiated. In addition to the different procedures, there are the additional factors of timing (e.g., before or after a game move) and scope (i.e., to what extent does this decision apply, how much of a precedent

does it create?). The figure below loosely maps the time of the procedure in reference to a game move. Some decisions occur long before a move is made (e.g., Choosing a game or reviewing official rules). Some are quite immediate: imperative instructions from a guide, for example. Also, black arrows indicate the expected scope of these decisions. For example, bending the rules is a temporary change to the way the game is played and does not mean to value as precedent. When players agree on a rule for a game, this decision endures much longer, perhaps even into future game sessions as a precedent. This chart is a rough model. It exists to first to help visualize the notion of timing & scope and as a way to graph the difference between to protocols.

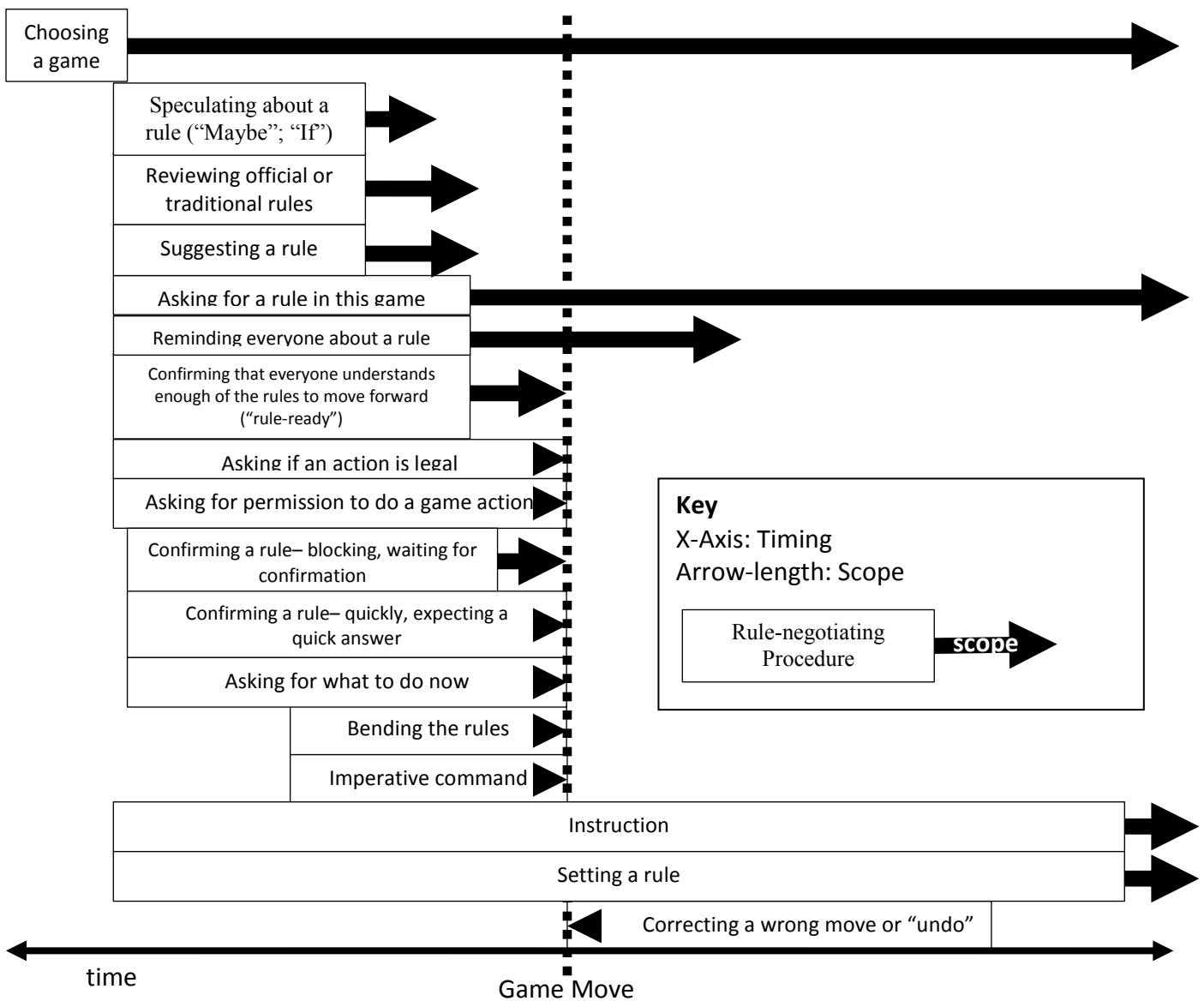


Figure 5.8.3 Loose map of rule-negotiation procedures against a game move.

## 6 Discussion

I opened this dissertation by introducing the need for flexibility in game systems. I was motivated by short list of potential activities that require rule-changing. My research questions were:

*[RQ1.1] In what ways do the design strategies of robustness and versatility facilitate playable game experiences?*

*[RQ1.2] In a flexible digital system, what communicative features are important for the negotiation of rule-changing by players?*

*[RQ2.1] What tradeoffs can be expected when comparing a manual game system (i.e., a generic playing-card simulator) against a fully-automatic, yet rigid, solution (e.g., Yahoo! Bridge)?*

*[RQ2.2] How can semi-automatic components be added to a robust game system to improve the versatility of a game system?*

*[RQ2.3] Given that flexible strategies do not necessarily overlap, what tradeoffs can be expected when a system is being designed both to be robust and automatic?*

Along with a definition of flexibility, I identified two major sub-strategies for designing flexible systems: versatility and robustness. I adapted Clark & Brennan's theory of Grounding in Communication into a set of communicative dimensions. I adapted Winograd & Flores terminology of ready-to-hand and present-at-hand for use in the domain of games into a set of Gameplay Dimensions.

I then designed Card Board, a semi-automatic flexible game system, as a form of design inquiry. I started by taking a regular deck of cards and recreated it in digital form. Compared to a typical card game system such as Microsoft Hearts, these designs were extremely manual. At this point in the project, the terms manual, semi-automatic, and automatic entered the design conversation. By emphasizing manual effort, Design 1 embodied the flexible strategy of robustness. The semi-

automatic features of Design 2 were designed to explore the concept of versatility by encoding addition poker rules into the system. In my design reflections, I introduce two new design terms: meagerly-supported and richly-supported. These terms accompany robustness and versatility. I also discuss lessons learnt on converting an automatic feature into a semi-automatic one and when to provide manual workarounds.

I then conducted an evaluative study with Card Board to observe players as they played. From my analysis, I was able to observe rule-negotiation, collaborative gameplay, and communication patterns. In addition, my analysis showed the usefulness of my gameplay dimensions for understanding play. Lastly, I introduced three themes of rule negotiation: mundanity, levels of readiness and the satisficing imperative, and a model of live-tweaking. Now, I return to my original research questions.

### ***6.1 How robustness and versatility facilitate playable game experiences (RQ 1.1)***

For research question 1.1, I can now describe the game experiences that are impacted by robustness and versatility. Robustness was achieved via a manual approach as inspired by physical cards. This was the design emphasis of Design 1's generic game board which had a wide array of features, meagerly-supported. The evaluation exposed a number of experiences affected by robustness. First, players could play many games in their preferred way from frivolous to competitive play and from speed games like Spoons to bluffing games like Blindman's Bluff. Second, players engaged deeply in the rules because the manual system required players to be rule-ready. Third, players were able to put their own meaning into the cards and chips on the board. Fourth, players adopted a set of mentalities about rule negotiation. Of them, those that appear related to robustness and manual approaches are (a) taking

leadership/initiative, (b) freedom to mess around, and (c) a sense of ownership over the game experience. Fifth, players believe that the openness of the system was a good system for teaching games. Last, robustness requires rule negotiation which adds more work to the effort of playing. As a chore it can be sometimes enjoyable and sometimes tedious.

Versatility was achieved via a semi-automatic approach that was built on top of Card Board's robust solution. Exploring versatility was the design emphasis of Design 2's richly-supported poker functions. By extending the intelligence of the system to encompass poker games, I was preparing Design 2 as an investigation of versatility. The user study surfaced game experiences that were affected by versatility and semi-automation. First, players clearly saw automation as a tool to eliminate uninteresting busy work. They specifically asked for automation to eliminate chores such as dealing cards and resetting the game board. Second, the embedded rules of the game influenced rule negotiation. For example, when the players in Session 4 switched to the semi-automated version, the small blind and big blind features were enabled. Because of this Danny took it as an opportunity to teach this betting style to the rest of the group. Third, novice players thought that the automatic aspects of the system helped them learn the game.

Overall, Card Board is as an example of robust and versatile design that shows the feasibility of these design strategies for facilitating a playful experience. Later, I will be discussing the limitations and tradeoffs for these two strategies. Meanwhile, I can satisfy the first research question by stating that enjoyable games can come from flexible strategies. Players laughed; they reported experiencing a real physical card game experience; they goofed off; they taught each other new games; and some even played extra rounds without being prompted to. The contribution for RQ 1.1 is a collection of design vocabulary (robust, versatile, manual, semi-

automatic, meagerly-supported, richly-supported) that can be employed in the planning stages, the design stages, and evaluative stages of the development process of a flexible game system. An additional contribution is the example of Card Board as a generic free-form game system that supports a rich set of player-determined meaning. I recommend following the lead of the article on the “Intelligent Use of Space” (Kirsh, 1995) and Cognitive Dimensions (Green, 1989) to inform the design decisions at this level. Also, I have contributed a recipe for reconstituting automatic features as semi-automatic features and offered a model for understanding the rule negotiation that will happen in such systems. Another key contribution is the understanding how flexible systems require a great deal of communication. This is addressed in more detail next.

## **6.2 *Communicative features that are important for the negotiation of rule-changing by players (RQ 1.2)***

Although many online games can operate with little to no talk (McEwan et al., 2012), Card Board was seen to rely heavily on audio conversation. Players reported that audio was critical to its success. Why? My findings suggest that audio is very well-suited to rule-negotiation, especially protocols where a quick response is favored. Audio is nimble. It is useful for quick confirmations of rules and longer exposition like paragraph-length explanations of rules. However, the door is still open for exploring other modes of communication such as gestures and game moves.

It is important to remember that Card Board could have been designed differently: omitting audio channels, offering more visual cues or embedding even more communicative meaning into the mechanics of the game. Indeed, this might be necessary in cases where audio is simply unavailable for many online games. To help address this challenge, I turn to contributions in this dissertation that are not merely the acknowledgement of audio, but are general claims about how

players communicate and negotiate. Specifically, I turn to my model of live-tweaking from Section 5.8.3 and towards my claim that players sometimes communicate as if they are contributing to a historic record. By “record”, I mean that players want others to see their moves or to hear them as they establish a rule that will extend long into the future. They communicate in the moment to set a precedent for the future. My model of live-tweaking (Section 5.8.3) draws attention to the aspects of timing and the scope of a rule negotiation. A momentary bending of the rules would look like a blip on my graph while a decision about suit-order would be a long line to indicate how the choice of Spades over Hearts would extend to the rest of the night. My recommendation is see what players want to say to each other during these protocols and ask how communication can be facilitated in a way that best fits timing and scope. For example, messages whose scope is expected to impact game decisions into the future are good candidates to be logged so that players can review past precedent. Messages that have an immediate impact on gameplay could be placed closer to the active areas on the game board (perhaps as floating text next to another player’s cards or cursor). Messages that are “messaging around” can be more ephemeral (perhaps text that fades over time).

In sum, not only do I acknowledge the primacy of audio for rule negotiation, I offer to answer RQ 1.2 by turning designers’ attention to my model of live-tweaking and a sensibility towards the role of time, scope, and retrievability so as to better support rule negotiation.

### **6.3 Tradeoffs and Design Implications (RQ 2)**

The following sections answer the second set of research questions in this dissertation. As a reminder, these are:

*[RQ2.1] What tradeoffs can be expected when comparing a manual game system (i.e., a generic playing-card simulator) against a fully-automatic, yet rigid, solution (e.g., Yahoo! Bridge)?*

*[RQ2.2] How can semi-automatic components be added to a robust game system to improve the versatility of a game system?*

*[RQ2.3] Given that flexible strategies do not necessarily overlap, what tradeoffs can be expected when a system is being designed both to be robust and automatic?*

#### **6.3.1 Fully automatic versus flexible systems (RQ 2.1)**

I have focused my design inquiry on the concept of automation. This is on the basis that the interesting difference between Yahoo! Poker and Card Board is the role of automation. My design process, design reflection, and user study have all targeted automation as the phenomena of interest. Thus, my answer to this research question is a rich description of how automation influences a game system when flexibility is desired. With a richer understanding of the contrast between automation and manual solutions, designers will be equipped to anticipate the tradeoffs between systems that are automatic, yet rigid, and those that are manual and flexible.

First, with design vocabulary introduced in this dissertation, I will describe typical game systems such as Yahoo! Games. This description, in itself, surfaces the differences between automation and manual solutions with a broad stroke. Automatic game systems are optimized solutions. They encode a majority of the rules of the game into their automated processes. These systems are optimal in that they sacrifice the robustness and versatility of a system for certain guarantees.

Primarily, full automation guarantees a smooth progression in gameplay. If players play the game as expected, less effort from the player is necessary for the game design, user interface, and game mechanics can all work in concert for a smooth flowing game. These systems guarantee a uniform set of rules. They guarantee non-cheating behavior. They guarantee legal play moves. A narrow number of use-cases are richly-supported while little to no support exists for alternate use-cases. The criteria of flexibility is completely lost. It is almost impossible to replay the set of games that my user study participants chose on any mainstream automated systems. There are too many different games and variants for a fully-automated solution to keep up. In sum, the first identified trade-off can be seen in the contrasting definitions of typical digital systems and Card Board. Fully automatic systems give up flexibility to gain optimal guarantees of uniformity, security, legality, and smooth operation. The gains of Card Board are, first and foremost, the feasibility of playing in ways that are simply impossible otherwise.

Second, I shall draw on the findings from the user-study to show the consequence of flexible game systems. Players of flexible systems adopt certain mentalities. The mentalities of rule negotiation include leadership/initiative and ownership. The theme of leadership and initiative comes as a matter of necessity. The manual system no longer embodies the rules of the game and someone has to take on the responsibility. Knowing the rules well enough to play (becoming rule-ready) is a requirement. As a result, extra effort is required from the players. It is sometimes tedious, but can be enjoyable: they have control over the pace of the game and quickly become engaged in the rule system. It is little wonder then that the capacity to play however they want and the deep involvement in the game rules is accompanied by a reported feeling of ownership over the game experience by the players.

My last point about automation is to discuss the relationship between automation and “readiness”. That automation distances players from the rules of the game is a phenomenon mentioned by other comparative studies between automation and manual in games (Wallace et al., 2012). In the case of “readiness”, that means that digital novices are often launched into situations where they are not ready to participate in the game, lacking the skills to play properly. Automatic game systems embed the rules in the interface such that it is impossible for players to make an illegal move. On one hand that means that even a clueless player will be able to join a game and play with experts. On the other hand, if that player is clueless, his actions will frustrate the experts. League of Legends by Riot Games is well-known for the way that novices are lambasted by other online players (Yubo & Nardi, 2013). Part of the reason for this verbal abuse is because novices are able to join games without a sufficient understanding of how to play. Analog games that have no digital crutch have a higher barrier of entry for novices. The notion of rule-readiness exposes this tradeoff. As such, digital designers are highly interested in guiding newcomers towards mastery (Desurvire & Wiberg, 2010). To teach a game well, one might anticipate how an automatic feature will work properly as a crutch for learning players or might put them at a level that they should not be.

Lastly, if automation makes it easier for players to skip ahead to rule-readiness, then I have identified a factor in digital games that pushes the game pace faster and faster. The game pace is no longer connected to a player’s awareness of the game rules, but rather towards their mechanical skill in using the game’s digital interface. If a player just clicks, he will move the game forward. This trade-off is a pitfall for game designers who want to bring a contemplative and social pace into a digital game setting that employs automation.

To summarize, research question 2.1 asks, simply, what is the difference between Yahoo! Poker and Card Board. The simple answer is that there are games that one just cannot play in Yahoo! Poker. Card Board solves this problem by easing away from automation so that players will not be confined to one set of rules. Thanks to the findings in this dissertation, I then take the time to explain what other effects automation has on the game. It guarantees a fast, smooth experience instead of a slower, manual game experience. Slower can be tedious, but it can also be fun in that players have control over the game, become engaged in the rules, and have a sense of ownership over the experience. Automation on the other hand, can keep players distanced from the rules and, in an unusual twist, can put novice players in a strange position where they don't know enough to play a game properly, but are already in the midst of gameplay – a bewildering situation for newcomers and frustrating for experts in the same match. In the end, there are a number of tradeoffs between the automatic and the manual. My recommendation is not to swing to one extreme or another, but to consider how to employ automation in a judicious manner. This leads to the next research question.

### **6.3.2 Adding automation to a robust system (RQ 2.2)**

How to add automation to a robust system? Add it in layers. Choose loci of flexibility. Consider how Design 1 and Design 2 both have automatic features. Even before I integrated poker rules into Card Board, I came to acknowledge that a purely manual digital system was not desirable. The inspiration for Card Board is a physical deck of cards. My first design concept was Design 0, a conceptual design that is as manual as possible. It was unplayable. Without automatic tools like shuffling or stacking cards together, Design 0 was far too unwieldy. Design 1, or the basic “manual” version of Card Board, actually has automatic functions for shuffling, stacking, arranging, and counting cards. Later updates to Design 1 included the capacity to select all cards

and chips, select only the cards, or only the chips because players needed the selection tools to be sophisticated enough to organize the game pieces. Design 2 heavily emphasizes automation for everything that players would need to play poker: understanding turn order, betting, and hand evaluation. Together, Card Board offers two loci of flexibility. Thus my first contribution in answering RQ 2.2 is to anticipate where the levels of automation should be. Like a cake, one would provide a layering of robustness, then another of automation, and more alternative layers as desired. Designs 1 and 2 respectively offer the ability to (1) play cards your own way and (2) play poker your own way. As it turned out, players leveraged each flexible locus. They played variants of poker games and they played variants of card games (non-poker).

My next contribution is the recipe that I introduced in my design reflection:

- a. Pick a locale of flexibility which is a baseline for your design.
- b. Take the list of automatic features that would typically exist above this baseline and decompose them into common functionalities.
- c. Find a way to offer an array of those functionalities to the player as a unified general function.
- d. Warning: Be willing to leave some of the overall system manual, understanding that manual modes may be necessary in a flexible system.

Thus, in summary, I recommend a layer-like approach to applying automation to a robust system. To preserve robustness, identify a locus of flexibility that the automated features can support rather than override. Once a locus of flexibility has been chosen, I offer a recipe for recomposing unwanted automatic functions as a common toolset for players to manipulate manually. The last piece of my recipe includes a warning that not all things can be fully automated in this way. This leads into the final question about the limits of combining these two flexible design strategies together.

### **6.3.3 Tradeoffs between versatile and robust design strategies (RQ 2.3)**

In my literature review, I conclude that there were no guarantees that flexible design strategies would not conflict. So, my last research question is to understand the tradeoffs between my two strategies, robustness and versatility. Conceptually, they address different aspects of flexibility, so it is reasonable to expect a degree of incompatibility. I explore the strategy for versatility in greater depth by focusing on the dichotomy between automation and manual.

#### **6.3.3.1 Incompleteness**

The previous section focused on the design strategies that make it possible to weave automation together with the manual. It included a recipe for success that closed with a warning that not everything can be fully automated. This is informed by the difficulty that I encountered when trying to implement the end-game for Texas Hold'em into Design 2. In my design reflection, I describe how automation fails in a robust environment because the number of variations for poker made it impossible to programmatically account for the winner. The possibility for wild cards, high-low options, and unusual arrangements of community cards made it all but impossible to say something that is as simple as, "you won the game." Instead, I had to give up the optimal guarantee of the automation for the game-deciding feature of a poker game and rely on the player's manual interpretation to retain the flexibility.

I could have made the endgame automatic. I could let the system just pick a winner based on a subset of the game variants, but this choice would severely undercut the robustness of the system. I stand by my decision not to do so since the user study showed that players did not like when the automated system pushed the players to play in a way that they did not want to play. For example, in Design 1, for the sake of consistency, I had the automatic yellow chip always move to the first player with the small blind. This annoyed expert players because they usually

think of the first person to play at the beginning of a round to be the person after the big blind. However, for me to implement the game that way would be to hardcode the default betting style to one idiosyncratic method. Hardcoding one method when two popular options exist is a recipe for always disappointing someone. For something as serious as the end-game, a system that misinterpreted the winner would be an equally frustrating experience if not worse, should the chips have been automatically collected into the wrong player's pile. So, this first tradeoff is that robustness competes with the ability for automated systems to offer 'completeness' in describing all the rules of a game. This applies to the most central functions such as the decision about who wins the game, not just obscure corner cases.

### **6.3.3.2 Interaction costs**

A second set of challenges for combining the flexible strategies is to find a balance among all the interaction costs of each design strategy.

Robust systems that require manual solutions can be highly cumbersome. Rule negotiation is a chore and potentially tedious. Looking back at the lessons learnt from designing Card Board, there may be situations where designers faced the same problem that I did which is to expect players to use manual workarounds to play how they want to. Unfortunately, a meagerly-supported workaround will create more chores for players. Despite the chance that the extra work is enjoyable (Xu et al., 2011), often the risk is that flexibility can make a system more of a hassle to deal with. When encountering this trade off, designs must be considered to minimize the cost of those chores.

Automatic features can clutter the workspace. Interference with the game flow needs to be minimized, especially all the extra options, widgets, and information that a flexible system may

impose on the player's circle of awareness. Flexible systems potentially offer options for players when they don't care to continually make those decisions. A simple example is how the Community Card zones created visual clutter for players who didn't use them. There wasn't a way to turn off a subset of zones. I had reasoned that players could just ignore the text that they didn't care about, but interviews have shown that having a clear, uncluttered table was preferable to players. From Session 3, Jane thinks of the basic version of Card Board as the more general version despite the flexibility and similarity of Design 2:

**Jane:** I think that -- well, it seems to me that the one where it's completely custom is more unique. (Design 1, Card Board without Dealer) And, I feel like if you focused on improving that and like making that looking really nice and people could use it to play any game that they wanted.

**Interviewer:** What kind of stuff?

**Jane:** I mean, I suppose they could ignore chips and just play any card game, but that might be a little strange.

**Interviewer:** Why strange?

**Jane:** Um... well maybe it wouldn't be. I guess. I guess if it were just marketed as a tool: "Play any cards online with friends" or something then it could work. Maybe you could hide the chips or something so they weren't a distraction.

Both robustness and versatility incur interaction costs on the players' skills, attention, and the kinds of decisions they have to make as they play a game. Judicious design choices need to minimize these demands in recognition that rule-negotiation is only a supporting activity to the primary one: enjoying a good game with friends.

#### **6.3.4 Summary**

In closing, the answers that I offer direct the reader to have a clear grasp of the design vocabulary that come alongside robustness and versatility. Next, because the communicative requirements for flexible game systems are high, I challenge design researchers to find

alternatives to audio channels which are admittedly well-suited for rule negotiation. Then, I offered a rich description of what automation is and how it intersects with different loci of flexibility in a digital game system. I discuss how to bring automation and manual solutions into harmony, but close by recognizing the tradeoffs that exist, one being that hybrid systems cannot reach complete automation. Overall, among the practical solutions in my answers (recipes for success, lists of tradeoffs, lists of gameplay implications), I have found that the theoretical models to be most helpful for guiding my understanding of flexibility forward. I turn now to examining how the theoretical insights from my dissertation can further inform the domains of computer mediated communications, game studies, and flexibility.

## **7 Conclusion**

Much of my work has been informed by theoretical models about play, interaction, computing, and communication. In the process of completing this dissertation, I have adapted and applied these theories. I turn now to discuss what contributions can be offered in return. There are three major implications that I will discuss here. I will discuss how my approach to communicative “dimensions” can inform our use of Clark and Brennan’s theory of grounding in communications. I will discuss a variety of areas of game studies that are informed by my work. Lastly, I will discuss flexibility of digital systems in general and how it intersects with related theory in CSCW and HCI.

### **7.1 Grounding in Communications**

At the beginning of my inquiry, I looked for theory that could inform my early stages of design. I anticipated that the communicative facet would be a critical aspect because of how much of the game play activity and coordination would be required. Clark and Brennan’s theory on Grounding in Communication (1991) promised to be useful in particular because their cognitive

theory explicitly discussed the role of the medium. Because of this, HCI and CSCW have drawn on this theory many times over to inform research on technology and communication. Like I did, researchers found Clark and Brennan's list of constraints ( Copresence, Visibility, Audibility, Cotemporality, Simultaneity, Sequentiality, Reviewability, Revisability) and made adaptations before applying to their own work.

First, they emphasized that although they are labeled constraints, they are not necessarily bad. This is an important distinction because it is easy to cite Clark and Brennan in the beginning of a CSCW research project as a motivator. The simple line of reasoning is: (a) Communication requires common ground. (b) The principle of least collaborative effort means that players need to have minimal barriers to establish common ground. (c) Computer-mediated communication is a poor substitute to face-to-face communication. (d) How can we reproduce the effortlessness of face-to-face communication via technology? Papers like these rarely return to the original concepts for more insight. In this line of reasoning, the constraints are used only as evidence that technological mediation is a poor substitute for the real thing. This of course was not the intent in the original text. Instead, the authors acknowledge that different constraints can be preferable in how medium and purpose interact. For example, the authors state that a phone conversation is sometime preferable to face-to-face: "Face-to-face conversations appear to be preferred for reprimanding, whereas telephone conversations or letters may be preferred for refusing an unreasonable request." (Clark & Brennan, 1991, p. 147)

Other researchers have successfully leveraged Clark and Brennan's list of constraints for design work and analysis. They explore ways to fit a constrained medium to a particular task. Birnholtz et al. (2005) examine grounding in settings characterized by reduced information and clarification needs where extremely lightweight tools can be sufficient. Dillenbourg et Traum

(2006) adapt the list to their needs to understand how two communicative mediums can be used in conjunction (an online MUD and an electronic whiteboard). Friedman and Currall (2002) use this list to dissect the negatives and positive influences of the email medium in escalating arguments. Preece (2000) also introduces the usefulness of these constraints for creating online communities.

Second, in the act of using these constraints, further adaptations were necessary. Like me, small adjustments were made to the list to better fit the context. For example, Dillenbourg and Traum rename reviewability to persistence. Preece also made minor adjustments to the definition of the constraints.

My work follows along these in that it employs Clark and Brennan's constraints in a useful way, avoiding seeing them as always negative. I also make small adjustments to the list and employ the communicative medium within a context with multiple ongoing channels and media (Skype and Card Board). I offer the following implications.

### **7.1.1 Rename the Constraints to Dimensions**

I propose to refer to this list of constraints as a list of dimensions. This is to combat the perception that face-to-face communication is a gold standard to which all other forms of communication fall short. This is a perception that has been pervasive for decades. The metaphor introduced by Holland et Stornetta (1992) is fitting here. They ask us whether we see communications technology as a crutch or as a shoe. A crutch is a poor substitute for a leg. A shoe augments a leg and allows new strengths to emerge. Likewise, do we, as a research community, allow mediated communications to be seen as poor substitute for the real thing (a "crutch")? A simple way to avoid that mistake is to readjust our use of Clark and Brennan.

I borrow the term “dimension” from Green (1989)’s list of cognitive dimensions because there is a lot synchronicity between the list constraints and a list of dimensions. Dimensions, like constraints, are useful for providing a common design vocabulary for evaluating the many facets of a design. They can be employed early in the design process just as I have done with Card Board and its communicative facets. Also, importantly, dimensions are explicitly value-less, meaning that they do not have in their definition a negative or positive connotation. This neutrality can be seen in the original work in Clark and Brennan as well as in the cited work above.

### **7.1.2 Domain-specificity**

Second, it is notably that the list of constraints requires adjustments. My work required adjustments and so did the papers cited above. On one hand, this implies that the list of constraints needs to be revisited and updated to become more relevant. This dissertation supports that need by showing what adjustments I needed to apply Clark and Brennan’s work to the domain of rule negotiation. However, my findings do not provide enough data across enough contexts to strongly dictate how an updated list should look. Meanwhile, what I can recommend is that design researchers should be taking the time to adapt the theory to their domain. This fits alongside the theoretical implication that is advanced by Dillenbourg and Traum (2006);. They emphasize that researchers should understand that grounding can be complicated (or simplified) according to the situation. So, in each particular situation, not only is grounding different, but so should be the constraints (henceforth, dimensions). In other words, before applying Clark and Brennan’s list of constraints, adapt it to your domain, and share that adaptation. I hope for two outcomes. First for games, as game researchers continue to refine the use of this theory in the games domain, we will better understand game-specific dimensions. Second, adaptations to the

list of communicative dimensions across different domains will ultimately inform how a generic, unified list might look.

Following my own recommendation to review the context-specific applications of these dimensions, I turn now to theoretical implications for games studies, starting with an insight based on the communication patterns in rule negotiation.

## **7.2 Game Studies**

The following are theoretical implications that cover a variety of subtopics in the area of game studies. This includes a framing of games as “law”, implications for gamification, and understanding player personalities.

### **7.2.1 Gaming is Law**

In rule negotiation, I identified a genre of communication that is the insertion and retrieval of precedent into a socially agreed upon record. Players sought a common memory of what the rules were and also what legal moves had been played in the past. They exhibited conscious effort to remain consistent with rules that had been established in the past. They played, knowing that their choice of game would impact play in the future, and they referred to the past, relying on precedent to decide what to do now. The word “precedent” has connotations to the field of law.

This connotation leads me to claim that “Gaming is Law.” This statement offers a contrast to the idea that the game is the code, that digital gaming is more about computer algorithms than it is about social negotiation. It is meant to remind us how absolute the rules of a game can be and how arbitrary. (Not that a legal degree is necessary to understand games.)

In support of this idea, I return to my mention of Bernard Suits's term for the 'lusory attitude' (Suits, 1978) in my literature review to support the understanding of games as a social agreement among players. Looking more closely at the nature of this agreement, there is a sense of absolute authority to Suits's lusory attitude. Suits defines it as the willing submission to the arbitrary restrictions and rules of a game. In other words, games are unmoored from typical rationales for efficiency or productivity in everyday life. Instead of running in a straight line, racers agree to follow a circular track. It is natural then that players who (re)negotiate the rules of a game, in addition to calling on external motivations such as fairness, or on pragmatic issues such as, "will this new rule work?", they would rely on the interpretation of the laws of the game and on rhetoric that will argue the validity of an action due to precedent.

Thus, I claim that "Gaming is Law" which is a phrase inspired by Lessig's (2008) well known phrase: Code is Law. Lessig shows that the field of law should be interested in how software architectures influence the law. My claim with "Gaming is Law" is to emphasize that games form a micro-sociological frame in which the basic foundation of the game experience is a collection of arbitrary laws.

This idea may seem obvious from the writings of game studies theorists such as Huizinga (1938) or Salen and Zimmerman (2004) who write about concepts such as the "magic circle" and rules of play in which the outside world is hedged away from a separate game world, but it bears emphasis for those who study game modification and communicative genres within games. In contrast to this lens, the interest in creating modification to games (Kücklich, 2005; Sotamaa, 2010) is focused on how a game is changed when the software changes. While embedded game rules have an undeniable impact on the game play, I want to advance a corollary to "Game is

Law” which would be that “Game is not all Code”. That is to say that to understand the software in its entirety is not enough to account for the total experience of a game. This would miss the understanding of a game as a social interaction, one where arbitrary rules are in play and treated as law.

“Game is Law” encourages us to take a “legal”-inspired lens at game studies topics. It introduces new questions for understanding the relationship between code and gameplay. For example, consider the area of game customizations. One can look back at the custom games played in a digital game like Halo 2 where I (Cheung & Huang, 2012) discovered that players invent custom games in which players must agree to “honor rules” which are not encoded in the game. Those who don’t abide by them are liable to be kicked out. The players agree, together, to shun these players.

Further investigation should compare the rhetoric strategies in legal contexts against the rhetoric strategies where players negotiate the rules of the game among themselves. There are many differences between these domains. For example, the Supreme Court is set in the real-world and the Card Board is explicitly frivolous. However, both contexts involve the debate about precedent and a systematic understanding of a rule-based system.

If “Gaming is Law”, one might also draw similarities between governance and game interactions as micro-sociological instances (Deterding, 2009; Taylor, 2009; Xu & MacIntyre, 2012) . Already, the communicative media in games borrows from a rough idea of governance: players in Team Fortress 2 have voting mechanisms for picking a new map or banning a player and massively multiplayer roleplaying games are composed of guilds each with their own

governance structure and roles. What are the communicative media that support these governing functions and how might they be designed better?

In summary, my observation of rule negotiation in live sessions of gameplay suggest that a “legal” perspective would prove valuable for understanding games and for contrasting against the idea that digital games are purely represented by software code. Promising future work exists in exploring the intersection between technology, governance, and game play.

I turn now to two more areas of game studies: gamification and player personality.

### **7.2.2 Gamification**

“Gamification” is an informal umbrella term for the use of video game elements in non-gaming systems to improve user experience (UX) and user engagement (Deterding & al., 2011). As a strategy for improving training activities (Abt, 1987), it faces the challenge of tying the game experience to the primary goal of training or teaching its users. Currently, the understanding of video game elements is still fairly new and exploratory (Schell, 2008) and its application to gamification leaves much to be done. The most common use of gamification is to add rewards (“badges”) and a leaderboard to a set of activities to incentivize users to do something. This simple approach is seen by some as manipulative (Bogost, 2011) and has prompted others to examine less superficial approaches (Nicholson, 2012).

The relationship between flexible game systems and gamification lies in the kind of play experience that players encounter when they play a game together. I have established that manual systems require initiative from the players to move the game along. One might consider how manual effort can better engross the players in a rule-system and, for example, better engross students in the materials that are being taught.

Additionally, the cooperative effort that players make to conduct a play session may be desirable for helping players guide and teach each other. This suggests that there are design strategies that can leverage a flexible game system to engage players in a game system quickly and effectively for accomplishing the training goals of a gamified training program.

### **7.2.3 Player personality and the play experience**

A difficult challenge for game studies is the ability to identify player types. A player-taxonomy allows designers to anticipate how that person will behave in a game context. For example, Bartle's breakdown of multi-user dungeon (MUD) players is design to allow designers to predict play style such as social activity or in-game achievements (Bartle, 1996). Recent efforts include the derivation of Big 5 personality of gamers from their in-game behavior (Shen, Brdiczka, Ducheneaut, Yee, & Begole, 2012).

In my own work, finding the connection between personality and player behavior proved to be a difficult challenge. A major question is to ask which factors are the best predictors? Emotional stability? Agreeableness? In this qualitative user study, my observation is that player's skill and the difference of skill among the group influenced the leadership style of the group. However, since this was not the primary question in my study and because of the lack of qualitative saturation, more work needs to be done.

Furthermore, the factors mentioned are not the only behavioral variables of interest. Additional questions exist for a number of different behaviors by players. And, there is research that makes predictions based on the Big 5 Personality traits of players for cooperativeness (Li & Chen, 2012), cheating (Rubin & Hubbard, 2003), creativity (Peterson, Smith, & Carson, 2002; Zabelina & Robinson, 2010), and playfulness (Woszczyński, Roth, & Segars, 2002). Future work should

include exploration of the connection between leadership style and skill level as well as exploration of these other behaviors.

### **7.3 Flexibility**

My last theoretical implication focuses on the central theme of this dissertation which has been to investigate the design theory for flexibility. I had originally introduced this flexibility with three simple criteria. Now, I present an update to this criteria.

#### **7.3.1 Updated criteria for flexibility**

What deems a system as flexible? Originally, I claimed that a flexible system has a wide array of rules that it can accommodate, can accommodate changes at any time, and can accommodate changes by end-users, not just software designers. As progressed in my dissertation, I have added refinements.

First, I advocate identifying a locus for flexibility. This idea was introduced in the literature review and has been further substantiated in my design reflections. For Card Board, the distinction between Design 1 and 2 showed different loci for flexibility. This same attention to “where” the flexibility resides will offer greater precision in understanding the flexibility of a system. Second, the rules that are supported by a flexible system can be meagerly or richly supported. This terminology also offers greater precision in my first criteria for flexibility. Lastly, I have adjusted “Who” criteria to account for the complexities of leadership and power between players who must decide among themselves about the rules.

Here is the updated criteria for flexibility:

A flexible digital game is a game system that allows players to decide on the rules to enforce, who enforces them, and when they are enforced. I now propose that games can be judged flexible in this way:

*a) How much can the rules change?*

- Given a set of potential rule-changes, how much of that set can be played within the game system?
- Furthermore, given a set of potential rule-changes identify which of those are richly-supported or meagerly supported (this will show the robustness and versatility of the system)

*b) Who can change the rules?*

- Who has authority over the adoption, interpretation, and enforcement of the rules?
- Are players offered equal voices in these negotiations? (Account for differences in skills, personality, and other factors that influence power)

*c) When can a player change the rules?*

- Before a game is adopted? During (e.g. live-tweaking)?

*d) Where is the flexibility?*

- Identify the loci of flexibility: at what level of general functionality to you expect players find new uses that were unexpected by the designers?

### **7.3.2 Designing for appropriation**

I now examine how my work informs the study of appropriation in HCI and CSCW. As seen in the user studies, players expressed a sense of ownership of the game experience. They took Card Board and used it to play the games that they wanted to play – even ones that I, as the designer, had not anticipated. In other words, they appropriated the software for themselves. They did this

without customizing or modifying the software. From a workshop on appropriation held at the European Conference on Computer-Supported Cooperative Work in 2005, this kind of appropriation was described as underexplored:

Perhaps the canonical interpretation of appropriation is that of customization and tailoring by users. Yet we felt that other interpretations, such as unexpected use of technology, or the socially constructed meanings around technology and its use that grow out of users' practices, were equally interesting and worthy of consideration. (Dourish, Herrmann, Kellogg, & Kunau, 2005)

The report closes with the following:

We can summarize the broad research issue at stake here as “how can we do more with less?” Rather than focusing on an expanding set of “cool” customization features, we ask how little can we get away with? How can we reduce the complexity of the technology, get it out of the way, while increasing and enhancing the ways in which individual users can profit from each other's experience, or that collectives of users can negotiate ever more optimal and suitable adaptations?

Progressing from this point, the field of HCI has begun to explore the area of unintended use of technology by supporting appropriative uses that do not require customization or modification. This includes guidelines for appropriation (Belin & Prié, 2012; Dix, 2007; Pekkola, 2003) and examinations of unexpected use in a variety of contexts (Ahde, 2007; Bødker & Christiansen, 2012; Vihavainen, Mate, Seppälä, Cricri, & Curcio, 2011).

Card Board fits in this conversation as a demonstration of how to support “unexpected use” in games. In addition to contributing an example of unexpected use, this dissertation suggests new ways to explore unexpected use. Here are a few suggestions.

First, my vocabulary for meager and richly supported workarounds can be used to describe how well-suited a designed artifact is for “unexpected use”. This leads designers to evaluate the appropriate-ability of an artifact after an unexpected use has been observed in the wild. For design, it offers the vocabulary to anticipate unusual uses by discussing what functions are richly or meagerly supported.

Second, Card Board examines the influence of automation on the overall experience of its players. The same question can be applied to appropriated technologies. For example, what social rules are embedded in the automatic features for technology in the home? Key themes in this dissertation have been automation’s influence on the pacing and tempo of the game, on the players’ sense of ownership and readiness to understand the rules of the game. Sensitized by this, I would ask similar questions in other domains: How do automated technologies control the pace of life and what strategies do users take to reassert their control over the pace of life, or their sense of ownership, or their deep understanding of whatever task that was being automated?

In sum, Card Board exists as an example of how to support “unexpected use”, a phenomenon of appropriation that is understudied in games. My findings encourage researchers to examine unexpected use with the design vocabulary for flexible systems (e.g. meagerly-supported and richly-supported use cases) as well as to interrogate the automatic features of appropriated technology to understand how they influence use (examples include pacing, ownership, and deep understanding).

## **7.4 Future Work**

Throughout this dissertation, there are promising branches of future work. Each section of the theoretical implications offers new areas to study.

Within the theoretical aspects of this dissertation, the dimension of communicative media were only explored in the context of audibility, visibility, and reviewability. The remaining dimensions may prove fruitful. The game dimensions were newly introduced and is a list that could be expanded to include more gameplay dimensions.

Within the user study, I screened out certain personality types. New ones can be examined. Also, the highly social aspect of rule negotiation suggests that much can be learned by examining a variety of configurations of personality and skill.

Card Board itself only explored semi-automation for poker games, more polish and more features might elicit new insights about flexibility. For better understanding versatility, one possibility is to add functionality for another type of card game, such as speed-based card games. This would better examine how two branches of richly-supported features might conflict with each other.

Finally, there may be addition design strategies for flexibility that might be taken from my literature review to be examined and adapted for used system design.

## **8 Closing Statement**

Returning to my initial scenario of a mother's search for her version of Cribbage, the good news is that it is feasible. The sociability, the pace, and the freedom of a regular set of cards can be replicated online. The tools for designing a system like that are the concepts of robustness and

versatility. The audio channel is enough to offer a rich channel for setting rules. And, I am able to predict about how well the different features of a flexible system, manual, semi-automatic, or fully automatic, will impact her experience.

Furthermore, I can say that we understand gameplay a little more. We have two sets of design dimensions: one for communication and another for gameplay that can be applied to any domain of communication or play. Also, with the explanation of the theory of ‘readiness’ and play, we have a theory that explain the progression of players from novice-to-skilled and stage-to-stage.

Moving beyond this dissertation, there are bigger challenges. I have taken an analog game and tried to bring its inherent flexibility into a digital conversion. However, an interesting challenge exists in the reverse. What would it mean to take a digital game, a first-person shooter or a tower defense game like Plants vs. Zombies by PopCap games, and recompose these genres as flexible game systems?

Another challenge would be to move outside of games and ask how automation and “readiness” impact a world that is being converted into a digital version of itself. Electronic checkout stands, automated homes, self-driving cars – these advances might benefit from a critical look at pacing, “readiness”, and human engagement.

After all, what richness might we be able to bring into our daily experience by bringing back a little more manual effort?

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## 10 Appendix A. Participant Selection Questionnaire

Here is the Participant Selection Questionnaire. It is the instrument that was used to screen potential participants. The questions here include contact information, the Ten Item Personality Measure (Gosling et al., 2003), and some questions about card playing.

Thank you for your interest in this study. Please fill out this questionnaire. It will help us determine your eligibility for the user study. This questionnaire is a total of 11 questions about yourself, about card games, and about online game services.

### General Questions:

Contact Email:

Age:

Here are a number of personality traits that may or may not apply to you. Please select a rating next to each statement to indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other.

1 = Disagree strongly, 2 = Disagree moderately, 3 = Disagree a little, 4 = Neither agree nor disagree

5 = Agree a little, 6 = Agree moderately, 7 = Agree strongly

I see myself as:

1. \_\_\_\_\_ Extraverted, enthusiastic.
2. \_\_\_\_\_ Critical, quarrelsome.
3. \_\_\_\_\_ Dependable, self-disciplined.
4. \_\_\_\_\_ Anxious, easily upset.
5. \_\_\_\_\_ Open to new experiences, complex.
6. \_\_\_\_\_ Reserved, quiet.
7. \_\_\_\_\_ Sympathetic, warm.
8. \_\_\_\_\_ Disorganized, careless.
9. \_\_\_\_\_ Calm, emotionally stable.
10. \_\_\_\_\_ Conventional, uncreative.

## Card playing Questions:

Please rate the following statements to indicate the extent to which they apply to you.  
1 = Disagree strongly, 2 = Disagree moderately, 3 = Disagree a little, 4 = Neither agree nor disagree 5 = Agree a little, 6 = Agree moderately, 7 = Agree strongly

- \_\_\_\_\_ "If it's a poker game, it matters how much money I make."  
\_\_\_\_\_ "I prefer larger stakes over small stakes for the chance to win big."  
\_\_\_\_\_ "To win money by pure luck is just as satisfying as doing it by skill."  
\_\_\_\_\_ "The people I like to play with are like me in that we play to win big."  
\_\_\_\_\_ "I enjoy the challenge of playing a game skillfully"  
\_\_\_\_\_ "I don't mind losing a round if I feel like I played well."  
\_\_\_\_\_ "I feel that off-topic conversations are an undesirable distraction to the game."  
\_\_\_\_\_ "I play mainly because it's a time to socialize."  
\_\_\_\_\_ "If invited to a game by co-workers or classmates, I am more likely to decline if the stakes are small to nothing."  
\_\_\_\_\_ "I don't mind losing in a friendly round with my peers."

Rate your skill in the following card games:

- 0 – Don't know how to play  
1 – I have a sense of what the game is about, but need to learn how to play  
2 – I know how to play but need reminders about the rules  
3 – I know how to play  
4 – I know how to play and I understand the game fairly well  
5 – I understand the game very well

Texas Hold'em	0 1 2 3 4 5
Draw (Poker)	0 1 2 3 4 5
Stud (Poker)	0 1 2 3 4 5
Blackjack	0 1 2 3 4 5

Dealer's Choice is a style of poker where the dealer gets to choose what game is played for the round. Have you played Dealer's Choice in a casual situation?

- No  
 Yes, rarely (less than 5 occasions)  
 Yes, on occasion (more than 5 occasions)  
 Yes, regularly (3 or 4 times a year or more)

Do you have an online account for a card game service such as Yahoo! Games, Pogo, PlayOK, Zynga, or play card games on Facebook? Y/N

If Yes, name one of these online games below.

Name of game and online service (e.g. "[Game Name] on Yahoo! games")

For how long have you actively played on these gaming services? (in months or years)?

How skilled are you on these game servers?

(lowest skill) 1 2 3 4 5 (highest skill)

Typically, how challenging are these online games for you?

(lowest challenge) 1 2 3 4 5 (highest challenge)

## 11 Appendix B. Participant Descriptors (Personality, Motivation, Skill)

Here are table summaries of the screening data, including group personality, player motivation, and player skill. Player motivation is derived from questions that compare player preferences between gambling, skillful play, and socialization. Player skill is a self-reported ranking of each players' expertise. The questions used for these numbers can be found in the Appendix A.

These statistics are offered as additional information to help readers determine the fitted-ness of my context for transferring knowledge to their own domain.

### Group personalities

	Extraversion	Agreeableness	Conscientiousness	Emotional Stability	Openness to Experiences
S1+	5.75	5.375	4.875	5.625	5.5
S2	4.125	5.5	5.5	5.5	5.875
S3+	4.25	5.25	6	5.5	6.25
S4	3.875	5.75	6.25	6.125	6.125
S5+	3.375	5.875	4.875	6.5	5.5
S6	5.333	5.167	6.167	5.5	5.833
S7+	4	5.833	5.833	6.5	6.167

Table 5.6.1.1 Group personalities for each session.

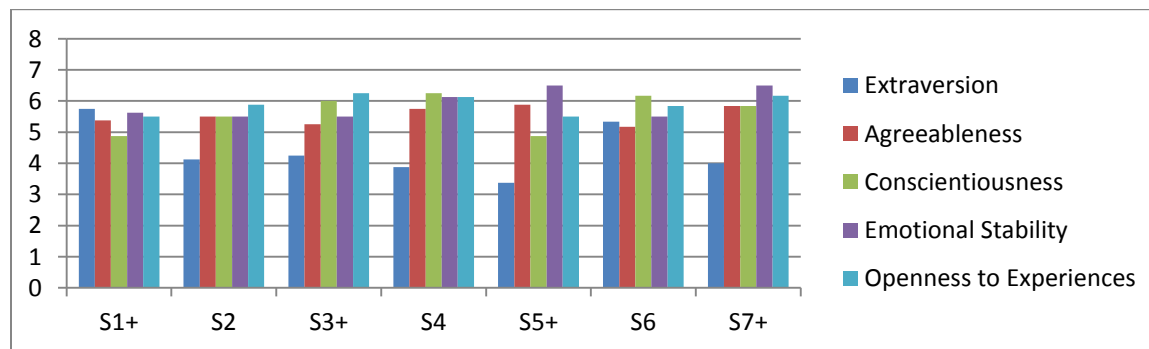
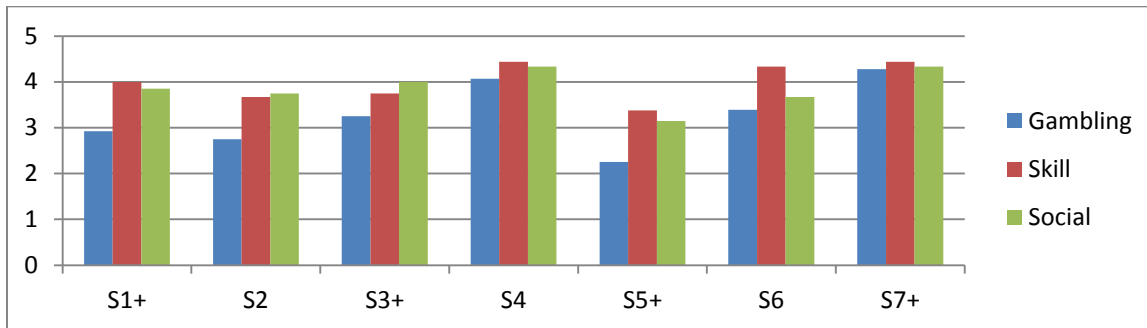


Figure 5.6.1 Group personalities for each session.

Player motivations

	Gambling	Skill	Social
S1+	2.92	4.00	3.85
S2	2.75	3.67	3.75
S3+	3.25	3.75	4.00
S4	4.07	4.44	4.33
S5+	2.25	3.38	3.15
S6	3.39	4.33	3.67
S7+	4.28	4.44	4.33

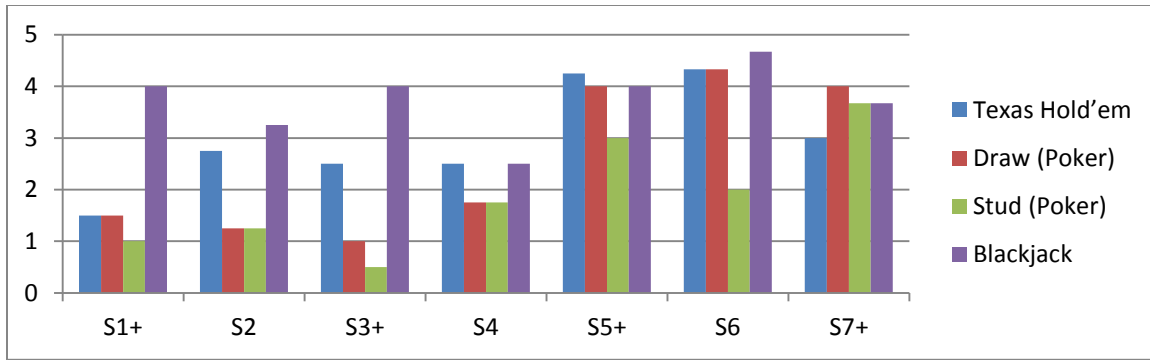
*Table 5.6.1.2 Group average for motivation to play cards.*



*Chart 5.6.1.1 Group average for motivation to play cards.*

Average	Texas Hold'em	Draw (Poker)	Stud (Poker)	Blackjack
S1+	1.50	1.50	1.00	4.00
S2	2.75	1.25	1.25	3.25
S3+	2.50	1.00	0.50	4.00
S4	2.50	1.75	1.75	2.50
S5+	4.25	4.00	3.00	4.00
S6	4.33	4.33	2.00	4.67
S7+	3.00	4.00	3.67	3.67

*Table 5.6.1.3 Group average for reported skill in poker games.*



*Chart 5.6.1.2 Group average for reported skill in poker games.*

## 12 Appendix C. Instruction Handout for Blindman's Bluff

# How to Play Blind Man's Bluff Poker

Blind man's bluff is a lot like any other games of poker, but with an intriguing twist. Players can see the hand everyone else has, but cannot see their own. The game is for true gamblers because while you can sort of glean your chances based on your opponent's hands, any bet is risky.

## Instructions

- 1  
Deal each player one card face down for the standard version of blind man's bluff.
- 2  
Reveal your card to other players. Traditionally, a player's card is revealed to other players but concealed from themselves by being stuck to the player's forehead. If you would prefer not to do this, simply hold your card up so you cannot see its value.
- 3  
Hold a round of betting. The highest value card in blind man's bluff wins. Players take turns making a wager on whether they have the high card. Rotate the first bidder to make the game fair to everyone.
- 4  
Evaluate the cards of other players as well as their bids to make your bet. The higher the value of other players cards, the lower the chance you'll win. However, also keep in mind how the other players who can see your card bet. For example, if all the cards you can see are low, but the bets are conservative, you might have a high card the other players are afraid of.
- 5  
Reveal your card to yourself and give the pot to the player with the highest card.
- 6  
Use the same principle to play blind man's bluff style versions of other poker games. Any poker game can be adapted to blind man's bluff by having the player's conceal their hands from themselves.

## 13 Appendix D. Group Interview Question Pool

Here is the question pool guided the post-game group interviews. My major areas of interest were the design aspects that motivated the design of Card Board: flexibility, communications, game-play, and notation. Due to time constraints I did not be ask all of these questions. Instead, I used this list as guide during the interview.

### *A. Question pool regarding flexibility and tradeoffs*

- a. Compare your experience with other card game software you have used before. (e.g. Yahoo or Pogo games, poker online, facebook games, mobile phone games) Was it easier to play? Would you rather have used it? How did you find the experience different?
- b. Would you want to replace any of the card games you usually play with Card Board why or why not?

### *B. Question pool regarding game-play*

- a. Did you have fun? Why or why not?
- b. Describe how Card Board compares to other types of card game software you've used. Did they represent the game in ways that Card Board couldn't? What was your experience making up for those problems?
- c. (Presence) Observations about changing goals in the game. (Are they trying to win the game, have they modified the goal of the game?)
  - i. When you focused on winning the games what parts of the software did you pay the most attention to? What distracted from that?
- d. (Presence) Observations about Non-gameplay goals such as: teaching, tweaking, transforming, performance
  - i. When you focused on teaching/tweaking/transforming/performing what parts of the software did you pay the most attention to? What distracted from that?
- e. (Readiness) Was the experience smooth for you?
- f. (Readiness) Where there parts of the experience where you felt like you were in the zone or playing smoothly?

- g. (Readiness) Where there parts of the experience where you felt like you were taken out of the game experience?
- h. (Readiness) Was there anything tedious about using Card Board to play?
- i. (Readiness) Do you remember any point where you would have liked the computer to help you or assist you in playing or organizing the cards and chips?
- j. (Readiness) Did you take any actions to help other people play more smoothly (e.g. moving chips/cards, why?)
- k. How would you compare Card Board to a regular deck of cards?

*C. Question pool regarding notation (for Card Board with Dealer)*

- a. Discuss the card-pattern language – and how easy or difficult it was to modify.
- b. Discuss the context of the language – How did the script help or hinder negotiations about rule-changes? Did the script seem open to changing in the midst of gameplay? Why or why not?
- c. Discuss the execution engine and Dealer’s design goal to share power with the users. Were they comfortable interrupting or correcting Dealer? Why or why not?

*D. Question pool regarding communication*

- a. Ask when the players got to the point where they believed that everyone was on the same page (“common ground”) about the accepted rules.
- b. (Visual) Was it helpful to see the cards, use a visual ping, or move them around to talk about the rules of a game? Was it not helpful in some ways?
- c. (Audio) Was Skype helpful for talking about the rules of a game? Was it not helpful in some ways? How does it compare to speaking in person? To communications with online games like Yahoo! Games?
- d. (Reviewability) To remember what the rules were, did you ever have to go back over the Skype record or look at the Card Board software to remember or review past messages? Was this easy or hard to do?

- e. (Reviewability) Note any use of the Card Board software to review previous messages (e.g. using the placement of cards or markings on the game board). Discuss its role in establishing common ground.
- f. Identify who (if anyone) took the leadership role in arbitrating rule-changes and ask why that person adopted that role. Discuss his or her particular methods of decision-making and how Card Board/Dealer helped or hindered those efforts.
- g. Note any communicative behaviors using Card Board as a communicative prop, discuss.
- h. Discuss out-of-band communications (not using Card Board itself).
- i. Did you feel that Card Board helped you communicate the rules with the other players? How?

*E. Discuss comparisons between v1 and v2 of the Card Board software*

- a. How did the playing, rule-changing, or communicative experiences differ?

*F. Learning the game rules*

- a. How difficult or easy was it to learn the game rules for each round of Dealer's Choice?

*G. Balance and Tweaking*

- a. I noticed that you tweaked the rules (cite observation). Can you explain that moment for me? What role did the software play for you in that moment? Was it easy, hard to do or explain?
- b. I noticed that you wanted to tweak the rules (cite observation), but you did or didn't. Can you explain that moment for me? What role did the software play for you in that moment? Was it easy, hard to do or explain?
- c. Did you feel that you could balance or tweak the game in away that you could not in an online game?

*H. Transformative play*

- a. I noticed that you were playing with the rules a little (cite observation).

- b. I noticed that you had a separate game going on top of the poker game (cite observation).
- c. Can you explain that playfulness for me? What role did the software play for you for that kind of play?

*I. Performance*

- a. I noticed that you were showing off or performing a little (cite observation).;
- b. Is this something that you normally do in traditional card games or online/digital card games? How was this similar or different than if you were using those?

*J. Tempo*

- a. Let's talk about the pace of the game. Did it feel rushed? Slow? Why or why not?
- b. Do you think the software affected that?

*K. Awareness*

- a. During the game, was it easy or difficult to be aware of what was going on in the game?
- b. How would you contrast this with traditional cards or with other digital games?

## 14 Appendix E. Participant Closing Survey

Here is the closing survey that was emailed to each participant after they finished the group interview. Depending on which condition they played Card Board, they were sent a version that asked questions primarily about Card Board Design 1 (“Card Board condition”) or Design 2 (“Card Board and Dealer”).

### 14.1 Card Board Closing Survey ( Card Board condition)

Thank you for participating in our user study. Please provide a few more details about your personal experience of playing with Card Board and Card Board + Dealer.

- 1. If there were any comments from the group interview that you did not get a chance to share, please share them here (agreeing/disagreeing with what we had talked about, additional thoughts about your experience of the software, etc...)**
- 2. The first system that you used was Card Board.**

How skilled are you at the games in Dealer’s Choice (consider them all together)?

(lowest skill) 1 2 3 4 5 (highest skill)

How challenging were the games of Dealer’s Choice (consider them all together) that you played?

(lowest challenge) 1 2 3 4 5 (highest challenge)

After playing for a while, how skilled would you consider yourself at using the Card Board software itself?

(lowest skill) 1 2 3 4 5 (highest skill)

To help us understand the skills required to use Card Bard, what parts of the software seemed the most difficult to use?

If there were any, what parts of the Card Board that you thought made the gameplay smooth and allowed you to focus on the game?

- 3. You had a small closing session using the alternate design: Card Board and Dealer.**

Using Card Board and Dealer, how challenging were the games of Dealer’s Choice (consider them all together) that you played?

(lowest challenge) 1 2 3 4 5 (highest challenge)

Using Card Board and Dealer, after playing for a while, how skilled would you consider yourself at using the Card Board and Dealer software itself?

(lowest skill) 1 2 3 4 5 (highest skill)

To help us understand the skills required to use Card Bard and Dealer, what parts of the software seemed the most difficult to use?

If there were any, what parts of Card Board and Dealer that you thought made the gameplay smooth and allowed you to focus on the game?

- 4. In the user study, we used Skype along with Card Board.** How difficult was it to talk about the rules of the game using Skype and Card Board?  
(very easy) 1 2 3 4 5 (very difficult)  
How did Skype/Card Board help or hinder your communication?

## **14.2 Card Board Closing Survey ( Card Board and Dealer condition)**

Thank you for participating in our user study. Please provide a few more details about your personal experience of playing with Card Board and Card Board + Dealer.

- 1. If there were any comments from the group interview that you did not get a chance to share, please share them here (agreeing/disagreeing with what we had talked about, additional thoughts about your experience of the software, etc...)**
- 2. The first system that you used was Card Board + Dealer.**

Using Card Board and Dealer, how challenging were the games of Dealer's Choice (consider them all together) that you played?

(lowest challenge) 1 2 3 4 5 (highest challenge)

Using Card Board and Dealer, after playing for a while, how skilled would you consider yourself at using the Card Board and Dealer software itself?

(lowest skill) 1 2 3 4 5 (highest skill)

To help us understand the skills required to use Card Board and Dealer, what parts of the software seemed the most difficult to use?

If there were any, what parts of Card Board and Dealer that you thought made the gameplay smooth and allowed you to focus on the game?

- 3. You had a small closing session using the alternate design: Card Board without Dealer.**

How skilled are you at the games in Dealer's Choice (consider them all together)?

(lowest skill) 1 2 3 4 5 (highest skill)

How challenging were the games of Dealer's Choice (consider them all together) that you played?

(lowest challenge) 1 2 3 4 5 (highest challenge)

After playing for a while, how skilled would you consider yourself at using the Card Board software itself?

(lowest skill) 1 2 3 4 5 (highest skill)

To help us understand the skills required to use Card Board, what parts of Card Board without Dealer seemed the most difficult to use?

If there were any, what parts of the Card Board without Dealer that you thought made the gameplay smooth and allowed you to focus on the game?

- 4. In the user study, we used Skype along with Card Board.** How difficult was it to talk about the rules of the game using Skype and Card Board?  
(very easy) 1 2 3 4 5 (very difficult)  
How did Skype/Card Board help or hinder your communication?

## **15 Appendix F. Codebook**

### **15.1 Negotiating Rules**

#### **15.1.1 Mentality**

Expressed personal perspectives related to the possibility of changing the rules.

##### **15.1.1.1 Leadership/Initiative**

Players take initiative to define the game

##### **15.1.1.2 Messing around**

A carefree perspective where impropriety, imperfections, and mistakes are allowable.

##### **15.1.1.3 Pragmatism**

Decision-making that is driven by immediate needs (E.g., deciding that it is too troublesome to explain a new rule)

##### **15.1.1.4 Idealism**

This is a complementary code to pragmatism. This theme was inferred through selective coding by reasoning that if players have a pragmatic attitude, an opposite mentality competes with it. Idealism refers to decision-making that is driven by an ideal vision of how a game is to be played.

##### **15.1.1.5 Ownership**

The idea that the rules are in the players hands.

##### **15.1.1.6 Rule-readiness**

The idea that enough rules have been established or understood and that they will work it out as they play.

#### **15.1.2 Problem**

Problems in negotiation require players to discuss or clarify the rules. They block the rule-readiness of the group. For example, some players don't know the game; players misunderstand rules; two rules seem to be in conflict; or, a rule needs to be established. (e.g., "Is an Ace high or low?" Chris, Session 4). Outside of the scope of rule negotiation, there are other problems that block the game such as interface problems or mistakes in play.

### 15.1.3 Reasoning

Reasoning that players use to justify a rule. Substantive examples include: favorite game, fairness of a rule, adapting to the skill level of the group, recalling rules from having played before, recalling how they'd been currently playing, and for the sake of keeping the game moving along. Notable sub-categories include:

#### **“That Works”**

Players agree that a rule or idea will work in the process of playing.

#### **Precedent**

Player recalling rules from having played before, recalling how they'd been currently playing all along and ways to keep the game moving along. Precedent was used to convince players to adopt a certain rule.

#### **Fairness & Impartiality**

Discussing what is fair and trying to project an impartial stance.

#### **No big reason (optional rationale)**

Claiming that a reason is not very important

#### **Negative precedent (forbidden rationale)**

Having played one way before and having experience a negative experience of it.

#### **“That can't work” (forbidden rationale)**

Claiming that a rule would simply not work in the process of playing.

### 15.1.4 Protocols

Protocols catalogue different activities that constitute rule negotiation. I label them as protocols because their frequency both during and across the sessions suggest these can become routinized.

Asking for a rule in this game

Asking for permission to do a game action

Asking for what to do now

Asking if an action is legal

Bending the rules temporarily

Choosing a game

Confirming that a rule applies – blocking, waiting for confirmation

Confirming that a rule applies – quickly, expecting a quick answer

Confirming that everyone understands enough of the rules to move forward

Correcting a wrong move, or undo

Imperative command

Instruction

Reminding everyone about a rule

Reviewing official or traditional rules

Setting a rule

Speculating about a rule (“Maybe”; “If”)

Suggesting a rule  
Unfinished negotiation about a rule  
Unspoken suggestion for a rule

### **15.1.5 Timing**

When do players discuss rules? Early, late, after the fact?

### **15.1.6 Scope**

#### **15.1.6.1 Temporary**

“Rule-bending” is when a rule is ignored on a temporary basis

#### **15.1.6.2 Permanent**

Typically, when a rule is established, it is in effect permanently

#### **15.1.6.3 Future Games**

The scope of a decision can establish a rule that will influence how future games are played. For example, choosing the order of suits will affect all of the games in evening, not just the first game played. (Selective code, inferred from protocols and rationale)

## **15.2 Gameplay Presence**

This is evidence that the players are attending to the main goal of playing the game. Winning the round, making a strategic choice, and other gameplay activities are examples. Each set of players in a game session may have different ideas of what challenges are considered part of the game.

### **15.2.1 Game Goal**

A certain goal or challenge is desired as a part of the game

*Game Progression* (State to State/Stage to Stage)

Actions that are considered those of playing the game, advancing from state to state. Players play as experts or as novices; they decide who wins the game; they concentrate on the game.

#### *State*

The game is in a certain state (it is a certain player’s turn, the game is over, the game has started, etc...). Players seek to identify the game state and declare it to one another.

#### *Stage*

A more specific type of game state, a game can be broken into different stages. A card game can be divided into stages which have sub-goals and rules. Stages can be formal or informally defined.

*For example, the formal stages of Texas Hold'em are the deal, Flop, Turn, River, and Showdown.*

## **15.2.2 Game Information**

Players follow the moves of other players and the changing state of the game. In a game, when players have finished a turn or completed their task, they signal to the other players that they are ready for the next stage of the game. Also, players may ask each other if they are ready for the next stage (E.g., to be dealt a card or to start the next player's turn)

## **15.3 Gameplay Readiness**

Gameplay readiness describes how Card Board serves as an unproblematic tool as players attend to the game that they are playing.

### **15.3.1 Breakdowns**

Breakdowns show how the players' attention breaks away from the game and attaches itself to an issue that is keeping them from attending to the game in the way that they desire. Breakdowns have different levels of severity as shown by the kinds of fixes that players rely on. Breakdowns are not universally defined across different games and players.

#### **15.3.1.1 Game system misinterprets the game state**

Misinterpreting who the current player is or what stage of the game it is

#### **15.3.1.2 Players play incorrectly**

Misdeals, out of order play, etc...

#### **15.3.1.3 Players misunderstand rules**

Players do not know a relevant rule, do not understand a rule, etc...

#### **15.3.1.4 Players mishandle the software**

(misclicks, unintentional actions, clashing actions, etc...)

#### **15.3.1.5 Players feel they are waiting too long for another player or for the game system**

Players feel like they are waiting too much

- 15.3.1.6 Hands-off!**  
Players give up control of the interface momentarily.
- 15.3.1.7 Cumbersome interface requirements**  
Passing the yellow chip, moving cards into precise positions for the Smart Zones.  
  
Sub-category: Game actions becoming tedious over time  
  
(The chore of passing the yellow chip was once acceptable, but is now too much work. Or, the shuffle animation was novel and “cool”, but now too slow for the player’s preference.)
- 15.3.2 Fixes**  
Actions that players take to overcome a breakdown and return to the main task of playing the game
- 15.3.2.1 Major fix**  
Resetting the game or redealing the round is done if the players feel that the game is sufficiently compromised by a breakdown.
- 15.3.2.2 Minor fix**  
Burning a card – A card that is accidentally revealed is “burnt” which means that it is considered out of the game or an “Undo” – The idea of retracting a single misstep. E.g., taking back a move.
- 15.3.2.3 No Fix**  
Players ignore the problem and try to keep playing the game
- 15.3.2.4 Social aspect**  
Ask for help – Players ask for help with a breakdown  
  
Group effort – Players work together to fix a problem, E.g., Multiple players help gather cards that a player missed when meaning to shuffle (Session S5)
- 15.3.3 Protection/Preparation**  
Work that players do to protect against potential breakdowns
- 15.3.3.1 Arranging the layout**  
E.g., Moving cards out of the way for less chance for mistakes

- 15.3.3.2 Agreeing on a rule that will minimize mistakes**  
E.g., Session 2, Blindman's Bluff: T1 had each player look at one card before putting another out to play.  
  
E.g., Session 2, Blindman's Bluff: T1 had each player flip the card back over before returning it to the owner
- 15.3.4 Skills**  
Skills that players need to be able to focus on the game
- 15.3.4.1 Understanding the game system's automatic logic, interface (areas, zones, etc...) , interaction paradigm (moving selecting cards)**
- 15.3.4.2 Understanding the rules of the game**  
Knowing the agreed-upon vocabulary for playing the game
- 15.3.4.3 Ability to remember**  
E.g., cards that you've seen, rules that were established, etc...
- 15.3.5 Non-gameplay Foci**  
Tasks that arise alongside the main goal of playing the game (perhaps in competition or accompaniment of the main goal)
- 15.3.5.1 Demonstrating a game or play**  
A player acts out a game round for other players
- 15.3.5.2 Making the chips look neat**
- 15.3.5.3 Playfulness**  
Jokes, laughter, etc...
- 15.3.5.4 Reflection**  
Reflecting on the game after it is over
- 15.3.5.5 Strategy advice**
- 15.3.5.6 Teaching**  
About the interface or about the game

## **15.4 Adversity**

Player descriptions of difficulty with respect to the interface or the game

### **15.4.1 Interface Adversity**

“Convenient”, “Easy to manipulate”  
“Difficult”  
“Intuitive”  
“Fast”/ “Slow”  
“Tedious” / “Cumbersome” / “Unwieldy”

### **15.4.2 Game Adversity**

Simple, Easy to play

## **15.5 Communication**

### **15.5.1 Audibility**

#### **15.5.1.1 Identifying Speakers**

Players identifying who is speaking

#### **15.5.1.2 Asking about the game state**

Players asking for information about the state of the game

#### **15.5.1.3 Declaring a game move**

Players making a game move primarily by speaking

#### **15.5.1.4 Describing a game move or an interface action**

Players describing their actions such as a game move or an action within the interface

#### **15.5.1.5 Describing the interface from one’s personal point of view**

Players describing what they can see from their personal viewpoint of the interface

### **15.5.2 Visual Channels**

#### **15.5.2.1 Gesturing**

Gesturing with the mouse cursor for others to see

### **15.5.3 Reviewability**

Within the context of playing a manual or semi-automatic card game I consider past communications, game moves, and interface actions (moving the mouse,

moving cards, etc...) as relevant for players to review. Also, within the context of negotiating the rules of a game, I consider previously established rules as relevant for review.

**15.5.3.1 Audio**

Reviewing past rules aloud.

**15.5.3.2 Game Log System (Located on the right-hand side of the automated version)**

Reviewing game moves using the game log

**15.5.3.3 Game layout**

Players relied on the layout of the chips and cards on the game board to clue them in about actions that had been performed in the past.

**15.5.3.4 Trailing Animations**

Watching the trailing animations of game elements.

**15.5.4 Game move as Communication**

A game move is a form of communication

**15.5.4.1 Passing the Dealer Chip**

Passing the Dealer Chip is the assignment of the Dealer role to another player.

**15.5.4.2 Passing the Yellow Chip**

Players may sometimes use the yellow chip to indicate status of a player (E.g., who the current player is). In the semi-automatic sessions, players are instructed to pass the yellow chip to indicate current player. In the manual sessions, there are no such instructions. (Session S5, after playing with the auto, the players continue to pass the yellow chip during their manual play session)