A Game of Research: Information Management and Decision-making in Daily Fantasy Sports

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ABSTRACT
In this study, we interviewed players of daily fantasy sports to understand their information management and decision-making behaviors. Due to the rapid cycle of decision-making that is required to play daily fantasy sports, we found that participants engaged in sophisticated and complex methods of information compilation and evaluation, using a wide range of digital and analog tools to help them organize vast amounts of information in a short amount of time. We contribute an account of these practices along with suggestions on how to further improve daily fantasy sports products.

Author Keywords
Fantasy sports; information seeking; decision making; daily fantasy

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; H.3.3 Information Search and Retrieval: Selection process

INTRODUCTION
Fantasy sports is a social game of skill [7] where participants create virtual teams based on real professional sports players. The performance of the virtual team depends on the statistical performance of the real players in actual sports games. The objective of the fantasy game is to build a virtual team that has the best performance out of a group of individuals competing with one another in leagues [27].

People compete with others at a distance to see who has the best team in a variety of different gameplay styles [27]. In some cases, the competitors all know one another and are part of a private, invite only contest. Other contests and leagues are public and open for anyone with an interest in playing. Each contest has rules, deadlines for completing certain activates, and different layouts of how wining or prizes are determined.

CHI PLAY '17, October 15-18, 2017, Amsterdam, Netherlands

ACM ISBN 978-1-4503-4898-0/17/10…$15.00
https://doi.org/10.1145/3116595.3116605

Fantasy sports players need information to help them make decisions as they play the game. This information used to be hard to obtain because it was primarily available in newspapers and specialty magazines, but the Internet has made it easier for people to have access to this information [18]. Moreover, being able to play with others online has helped increase the popularity of this sport [32].

Daily Fantasy Sports (DFS) is a relatively new form of fantasy sports game play. DFS requires people create their fantasy teams on a frequent and short-term basis to win prizes, but little is known about their decision-making process for creating team line-ups. One of the main differences separating daily from the traditional seasonal fantasy is the turnaround time on investment. Because DFS players have to make so many decisions within a short timeframe, their process of information seeking, organization, and decision-making could be very different from players of season-long fantasy sports. This makes DFS a unique context for HCI gaming research, because players play within a social system, yet have to use information resources outside of the system to inform their gaming behavior.

In this paper, we ask three key research questions aimed at understanding how people undergo this decision making process in the context of daily fantasy sports: *How do people decide which players to choose for their line-up? What resources—both social and informational—are used to make these decisions? What types of technology are used in the process?*

The contribution of this work provides insight into how people make short-term financial decisions on constantly-evolving events through their information seeking behaviors. The results also provide a set of design guidelines for online DFS services to best support their products.

ABOUT FANTASY SPORTS
The first public fantasy league was introduced in 1969 by Andy Mousalimas, who was the founder of the Greater Oakland Professional Pigskin Prognosticators League (GOPPPL) in 1963 which started the first drafting of players into a league [24]. The baseball fantasy league was started in the 1980's by sportswriter Daniel Okrent in a Manhattan restaurant named La Rotisserie Francaise which

led to the naming of the first fantasy league "rotisserie league baseball" [24].

In 1988 it was reported by "USA Today" that the participation had grown to an estimated 500,000 players [37]. In 1997 the first two Internet fantasy sites, RotoNews.com and Commissioner.com, were launched and the new favorite past time took off and running. In 2007, Chris Fargis, a professional poker player, introduced the first daily fantasy sports format through his blog called Instant Fantasy Sport [38].

Since the beginning of online fantasy leagues the number of fantasy sports participants has risen dramatically from 500,000 in 1988 to approximately 56.8 million as of 2015 according to the Fantasy Sports Trade Association [16]. According to the trade association's 2015 research it has been found that 66% of general fantasy sports participants are male; the average age is 37; and the primary fantasy sport played is football [16]. The survey also found that the number of players who play some form of daily fantasy sports has increased from 31% in 2012 to 64% in 2015, and one of the contributing factors to the growth in fantasy sports is the ability to manage teams from mobile phones. There are a variety of DFS providers including FanDuel, DraftKings, and Yahoo Fantasy Sports.

Based on work within the HCI field on gaming, fantasy sports may classified as a type of pervasive game play [22] or more broadly, pervasive play as it involves "technology-mediated, playful experiences that are interwoven throughout our everyday lives and the physical and virtual spaces we inhabit"[1]. By leveraging real-world events during sporting events, fantasy sports augments through gameplay, similar to games such as Augmented Reality Games (ARG), or Live Action Role Playing (LARP) game genres. In addition to being a pervasive game, other research has categorized fantasy sports as a type of data-driven prediction game in which data sets are used to inform playful and social interactions [12]. These categories of game play are not mutually exclusive; rather, both support and capture the multifaceted fantasy sports experience as a form of an online community. We situate our work in game research as a part of the of practice paradigm of game research, focusing on "experience and consequent interactions between users that occur as a result of interaction with the game, or as a result of entering a lusory attitude." [9]

Motivations for Playing Fantasy Sports

The motivation for playing fantasy sports crosses interdisciplinary boundaries. Dwyer and Kim [10] were able to validate three motivational dimensions: entertainment/escape, competition and social interaction. Entertainment consisted of enjoying the game play was a fun way to pass time. Escape was a motivation by using fantasy sports as a way to mentally take a break from daily rituals such as work, school, or other personal responsibilities. Social interactions in fantasy sports supported creating and maintain relationships with others through game play. Finally, those who found motivation in the competitive aspects of Fantasy Sports were driven by the need to both win and be seen as the best by his or her competitors [10].

Billings and Ruihley have conducted a series of sociologically-based studies around the motivations for playing season-long fantasy sports [4,28,29]. In their research, they identified motivations including enjoyment, arousal, escaping daily life, passing time, information seeking, fanship, demonstrating sports knowledge, helping others find information, and self-esteem.

Another study conducted by Farquhar and Meeds [15] on motivations of fantasy sports usage found additional categories of motivation to be more influential. Although entertainment/escape, competition, and social interaction were factors in motivating fantasy usage, surveillance and arousal were judged to be more important motivating qualities. Surveillance includes the process of gathering information, working with statistical data, and staying closely connected with real-world sports. Arousal motivates users to participate in fantasy sport gameplay for the trill of pursing the next big victory.

By analyzing these motivational factors among fantasy sports players, the researchers [15] developed a framework of types of players. The three most prevalent player types include 1) *Casual Players* who invest less time, money, and effort into fantasy sports, but enjoy the game for fun; 2) *Skilled players* who invest a large amount of time, money, and energy into fantasy sports (high levels of surveillance) and who feel a sense of accomplishment the more they invest into the game (arousal); and 3) *isolationist thrill-seekers* who have a high level of arousal for winning, but don't want to put in as much of the surveillance work required.

These qualities of entertainment, competition, social involvement, surveillance, and arousal all contribute to reasons why sports enthusiasts are motivated to augment their sports watching habits with fantasy sports and provide evidence that suggests that fantasy sports is a complex game that involves viewing, information gathering, and decision making, financial investment, and entertainment.

Daily Fantasy Sports

Daily Fantasy Sports is a rather recent way to participate in fantasy sports on a daily or weekend basis versus an entire season like the traditional season-long leagues. The first DFS providers began gaining traction in 2010 and have continued to grow. Building a virtual team is referred to as "crafting" or "drafting" a lineup. The ability to create/draft lineups daily and the nightly turnaround time on entry results seem to be drawing people away from the seasonal leagues over to the daily fantasy sites [26]. There are several key differences between traditional fantasy sports

and daily fantasy sports. With DFS, you see quick results from your games that are played on a daily (or sometimes weekly) basis as opposed to waiting until the end of the season, which lasts multiple months. With DFS, you have the opportunity to draft a new lineup everyday versus having a lineup that is drafted at the start of the season for the entire season with very little room for trades or changes.

The second difference is social dynamics of leagues compared to contests. In leagues, individuals get to know one another through the routine interactions they have across the longer duration of time. There is a consistency in social interactions. With DFS, the competitors may or may not continue to participate each week. Also, DFS is more likely to be played against strangers than with leagues which often include friends, coworkers, and family members.

There is also a major monetary difference in league and DFS. In many cases, individuals will pay entry fees into fantasy sports contests or leagues. The winner of fantasy sports (or the top several placers) will receive a payout based on their performance. Full-season fantasy sports usually provides this compensation at the end of several months of gameplay. However, those playing DFS receive their prizes immediately after their short contest of a day or week. This provides more opportunities to win prizes, as well as more immediate returns on their entry fee, when applicable.

Although motivational factors may not differ between traditional and daily participants, the two types of fantasy play influence different media consumption, monetary commitments, and perception of fantasy game play [5]. DFS sports participants are significantly more likely to consume more fantasy sports media. Additionally, participants who played DFS are more likely to consider a higher proportion of their ability to win to be based on skill rather than chance. In part, this was due to investing into research efforts for selecting lineups.

DECISION MAKING

Shipman [32] has called for the HCI community to further study fantasy sports (which we specifically extend to DFS) as a means of understanding how entertainment-based domains focused in bridging the virtual and physical worlds are mediated by our devices, especially in terms of active and passive engagement with sporting events . One such way DFS supports active engagement between these two spaces is through making decisions as part of game play.

DFS, like traditional fantasy sports, relies on choosing sports players to create virtual teams, which are called lineups. There is an abundant amount of factors that lead people to these decisions, and oftentimes the choices involve conflict because there are too many variables [25].

Decision Support Systems (DSS), defined as interactive and technologically-mediated systems designed to support handling and management of large amounts of data to support and improve a decision process [2], have been studied in HCI in a variety of contexts including eSports, investment decision making [3,6,17,36]. Although DFS players may be pulling from different source, little is known about how they create adhoc DSS to help manage their lineups.

In the world of fantasy sports there is a plethora of both professional and collegiate sports to select from and a variety of fantasy sites that offer opportunities to experience different levels of participation as a team member in a league or as an individual contestant. The research on decision-making processes in season-long fantasy sports indicates that it is a complicated process that involves much data and data analysis [11,18].

Despite its popularity, research on fantasy sports is lacking in general [27], and with very few studies within the HCI community, but there are even more limitations on DFS studies, a relatively new genre. While DFS shares many attributes with season-long fantasy sports, the shorter daily timeframe creates a unique situation where those playing DFS need to make decisions about their lineup in shorter intervals, giving people very little time to ponder over their choices. With a limited timeframe, it is very likely that DFS players rely on heuristics to make their decisions [35]. Heuristic decision-making is different from rational decision-making in that the former is unable to make a comprehensive assessment of the factors at play due to cognitive limitations such as time and money.

Studies on full-season fantasy have shown that players focus on various attributes of the athlete [33], but it is unknown what factors influence daily fantasy sports players. Our first research question thus inquiries into understanding what informs and supports DFS players when they are putting together their lineups:

RQ1: What factors influence how people decide how to build their lineup?

INFORMATION MANAGEMENT BEHAVIORS

Several studies have explored the ways in which users seek and manage their information for leisure activities [14,19], or in everyday life [31]. However, most of the literature around fantasy sports has been within media studies, sociology, or sports marketing [18]. For DFS, more research has been conducted in the legal domain.

DFS has been criticized and is banned in certain states in the United States for being a form of gambling [20]. DFS has been the focus of a recent debate on if the model of gameplay and Daily Contests is considered a form of gaming due to some contests having an entry fee and prize model. Recent court decisions have ruled is a game of skill and exempt under the 2006 Unlawful Internet Gambling Enforcement act. While there is some degree of luck is associated with any sporting contest, in order to consistently do well in fantasy sports, players must have knowledge about the sport and the players involved. A

fantasy sports user creating a lineup must have skill and knowledge of the professional players and understand the factors influencing their performance during games. As such, this skill and the knowledge is what drives the ability to win, rather than just luck, and is considered a game of skill and requires a deep understanding of sport.

Since the performance of DFS relies on the performance of actual sports players, some of that performance can be predicted through probability (statistics based on past performance) even though there will always be unforeseen chance factors that influence the outcome.

Because some proportion of future performance can be predicted by past performance, many DFS players engage in research. In particular, within the HCI community, Dzodom and Shipman [11] found full-season fantasy sports players struggle to find any given source to satisfy their information seeking needs and therefore use a variety of sources to gather and manage data informing their fantasy decisions, with over half of their survey respondents using 5 of more data sources to triangulate data.

Hirsh et al. [18] also found that players used multiple sources when playing season-long fantasy NASCAR and Football. In their research players often searched for different information based on stage of the season (i.e. drafting, game day, playoffs), and found that information seeking needs varied by task, but called for additional research on broadening the type of fantasy sports included which we aim to accomplish through researching DFS.

According to Eilers Research's *Daily Fantasy Sports Player Survey-2015*, most players spent between 10-20 hours a week doing research and RotoGrinders was the preferred research site [21]. According to RotoGrinders' website, they provide fantasy sports content, member blogs, player rankings, and discussion forums. On this site fantasy sports participants can sign up for a free or premium account. The site offers the utilization of research tools, some are free and others have fees, to aid in creating one or more lineup options across multiple sports and/or multiple fantasy sites. Under their DFS Alerts a participant can filter through all or specific sports alerts (i.e. MLB, NFL, NBA) using the desired tab of all, urgent, important and noteworthy; by doing this the participant is able to obtain updated information regarding players that they may be drafting for current and upcoming games.

Eighmey and McCord [13] were able to establish the importance of website organization and design as factors that drew consumers to become repeat visitors websites. By studying participants' usage across multi-media platforms it was found that the top uses and gratifications dimensions were entertainment and information.

Nadelson, et. al [23] found that participants engaged in "heutagogy" (self-determined learning). This type of information seeking is not lead by a set list of rules or instructions, it is free flowing according to the user. This process is seen when fantasy sports participants are deciding on which fantasy sites to participate on; which sites are trustworthy and which sites hold the most informational value. The fantasy sport player makes the determination on the path they are going to follow during their information seeking periods. The participants retrieve this information from multiple entities and make the final determination on what information is pertinent to their lineups.

Taking a sense-making approach [30] by focusing on a user-centered approach to information use, our study examined the amount of time spent collecting data, exactly what participants are researching, how they are conducting this research and why they do the research.

RQ2: What methods are being used to gather the information?

RQ3: What methods are being used to organize information?

METHOD

Recruiting Method

For our study we posted a short survey on Mechanical Turk that offered participants $1 for completing the survey and the opportunity to volunteer for interviews. Participants that wanted to volunteer for the interviews provided their email information at the end of the survey. When the survey period was closed 87 out of the 323 completed participants had volunteered; emails were sent out to participants to schedule interviews. From multiple rounds of emails sent, 14 out of 87 actually participated in the interview sessions. These participants were considered to be low spenders since more than half of them entered contests for free and out of the paying participants, $20 was the highest paid entry fee. Since we were looking for a broader spectrum of player behavior additional emails were sent out to Yahoo! Sports VIPs through a contact at Yahoo! who was unrelated to this research. In total we conducted 21 interviews where each participant was compensated in the form of a $20 gift card upon completion of the interview.

Interviews lasted from 30-45 minutes and were audio recorded with the participants' permission. The recordings were transcribed by three research assistants and double-checked for accuracy by the primary researchers. Thematic analysis [8] of the transcripts was used to develop the themes for each of our research questions.

Participant Demographics

In our study we had a total of 21 participants that were interviewed: 18 male and three female with an age range of 18 to 52. Participants were from both urban and rural regions across the United States, but mostly White in terms of ethnicity. Aside from one participant who played DFS professionally, all participants had jobs that were not related to DFS or sports. We asked them about all of the daily fantasy they played, but the interviews took place

during American football season, so most of the questions focused on the context of daily fantasy football.

Participant	Sex	Age	Ethnicity	Duration playing DFS
James	M	35	White	2 years
Hector	M	44	Hispanic	25 years
Derrick	M	52	Black	4 years
Joshua	M	37	Hispanic	3 years
Luke	M	29	White	2 years
Mark	M	26	White	2 years
Peter	M	38	Mixed	10 years
Penny	F	47	White	2-3 years
Sheldon	M	35	White	3 years
Leonard	M	36	White	3-4 years
Howard	M	32	White	3 years
Stuart	M	18	White	1 month
Felix	M	24	White	2 years
Paul	M	25	Black	3 years
Donnie	M	33	White	10 years
Sarah	F	40	White	2 years
Arthur	M	49	White	2.5 years
Vic	M	34	White	2 years
Helena	F	35	White	1 year
Rollin	M	28	White	2 years
Castor	M	40	White	14-15 years

Table 1. Participant Demographics and Duration of Fantasy Sports Participation

RESULTS

General Characteristics of Players

In our study participants averaged between 5-30 hours a week conducting research to inform their lineup selections. The leading "research sites" were DFS sites, ESPN.com, Yahoo, and NFL.com. Mobile phones and laptops tied as the top devices used during their research periods, followed by tablets and desktops. The top mobile applications used were NFL and ESPN. One-third of the participants said that they receive notifications from their apps.

The top four DFS sites used by our participants were FanDuel, DraftKings, Yahoo!Sports, and SportsLine. Their entry fees spanned between $0-$5,000, though most participants spent under $20. Some of the other DFS sites that the participants frequented were: RotoViz, FootballOutsiders.com, ProFootballFocus.com, NumberFire.com, DailyFantasySportsRanking.com and NFLToday.com.

When speaking with the participants of our study, the majority stated they gained a broader experience with the sport that they were participating in. It was an added form of entertainment beyond the games that also gave the possibility of monetary gain. The participants stated that through daily fantasy sports they were able to gain a better appreciation for the sport and the players through the research they conducted prior to drafting players to their lineups.

Penny, a 47 year-old female that has been playing DFS for about 3 years, talked about how playing changed the sport for her:

> *"I think it actually gets me a little more excited as well for the game which makes watching it more fun. I do think it's a really great tool for teaching people about the game and how it works. So that's probably the most fun that I've had with it, learning about the game."*

Castor, a 40 year-old male has been playing daily and seasonal fantasy for a total of 15 years, pointed out how participating changed his outlook on sports:

> *"It's made me more appreciative and more aware than I was before in general… it's given me a better appreciation of how the game itself has evolved, not only from when I started playing fantasy sports, but how it's have changed from then to now. Even more so it's allowed me to appreciate players from other teams, other conferences and other players."*

Factors That Influence Lineup Decision-Making

Our first research question was asking about what factors influence how people decide how to build their lineup. While talking to the participants of our study we were able to see different types of factors that would drive a daily fantasy sports player to the selections that they make regarding their team lineups and site selections. Some of these factors, such as player statistics, were those already documented in the literature of traditional (season-long) fantasy sports, but others were less intuitive.

Player information (background, injuries, past performance)

Participants discussed about how different aspects of the player's background and performance influence their decisions. All participants were interested to a certain extent in objective facts related to players, such as statistics, how long they have been playing, what teams they've been on, or injury reports.

For example, Howard said that when debating with himself what player to choose, he would first go to the news, then look at player statistics before making a decision.

Similarly, Hector said:

> *"I'm looking for, you know, any type of information that could help me; from the players going up against an untested player, or there's been an injury in a key position that might help a player that's going up against that particular defense."*

While all participants relied on some numerical form of player statistics to inform their choices, those who had been playing DFS for several years or more had more elaborate, established routines that were formulaic and developed over a long period of time, based on longitudinal information. These routines were like *heuristic sequences*, in which participants had a mental model of "do this first, then this, then that."

These heuristic sequences were best exemplified by Castor, who said that he uses what he calls a "three-two system" for selecting his players. He first looks at who is still available to draft and then weighs them against who they are competing against that week. If it looks like the match will be close he goes to what he calls "task performers" who have great overall records or pick from his favorite team—in his case, the New York Giants.

Soft Traits and Personal Life

While objective facts played a major, if not the biggest role in decision-making, we noticed that participants also relied on subjective factors that may seem not directly related to physical performance. A few participants looked at "soft" characteristics of the athletes, such as drama in their personal life, perceived personality, or an emotional connection.

Peter is an avid fantasy sports player since his days in the military and he makes it a point to know his players and who they are involved with romantically, as he states it bleeds over into their professional careers. He gave the example of basketball player James Harden dating reality television star Khloe Kardashian:

> *"So for instance, people would say James Harden, very good basketball player but the reason why I stay away from him while drafting him is because he's dating a Kardashian… He's a good player, but he's one dimensional… and taken even more of a hit ever since he's been with 'that'. So you kind of have to look up certain things to see how it's affecting the player."*

Helena, a 35 year-old woman who has been playing DFS for 1 year, said, "Of course I look at the stats as far as wins versus losses, but also other things like their demeanor on the field, personalities, if I can find that information; um, you know, like their style of playing or style of teamwork." She went on to state that if she's spending a lot of time doing the research, she wants to feel an emotional connection with the players: "I mean it's like which one resonates with me; which ones do I feel are closer to; or that I feel are the ones that would be interesting for me to follow."

Two participants discussed about how they took a long-term approach to identify potentially good athletes—sometimes even years in advance—by focusing on personality. For example, Mark said he constantly looked for athletes who did not do well but had traits that he thought would make them perform better in the future:

> *"[There is] value in the lower end player… generally everyone knows who the best players in the league are so I'm trying to find the underdog so when they perform well the public won't see that coming. Like a more psychological approach to it rather than just statistical."*

Peter stated that he becomes familiar with the players before they even reach professional status by watching college sports to see how they perform in their positions. Through this, he stated that he is looking at "somebody's tendencies; how they are in the team."

Simulations

Multiple participants mentioned using statistical programs or websites to test-run their lineups. Leonard is a 36 year-old male that has been playing DFS for about 4 years. He said that uses a simulation site called DailyFantasyMirror, which he described as a "PC-like game."

Some were projecting into the future with simulations based on algorithms set by the system that they were using or as a supplement to their own algorithm that they built over years of participation.

Hector stated that he uses his own spreadsheets combined with RotoGrinder to assist him highlighting potential players from a generally developed list. He said that he uses the lineup generators about 20% of the time because they "generate lineups for me and highlight certain players. It has an essentially good algorithm."

Howard said that he thought it would be very difficult to win without running simulations because the simulations are more likely to be better than himself at identifying good players who are not big names. "What happens is you pick a few big names and you pick a few longer shots, but you usually do a so-so job," he explained.

Extenuating Criteria

While participants stated that they based their lineup decisions on statistics like prior performance, injury history and other factors that can be found across multiple sports platforms; they also stated that there were other critical factors unique to themselves that had to be met for them to decide that they were going to take the time to conduct research and create lineups and participate in any contests for that day.

Paul is a 25 year-old male that has been participating in DFS for 3 years. He stated that he enters contests every day of the week when there are games scheduled except when there are no games airing that day that he can view.

Stuart is an 18 year-old male that is new to DFS as he has only been playing for one month. He stated that his participation is based on not only what he is doing for the day but also his ability to view the games and if he has the financial means to enter.

Derrick, who has been playing DFS for 4 years, stated that his criteria for participation includes looking at the fantasy sites, the site's scoring system, correlations between the number of teams playing that day and number of contests because he only plays when there is a minimum of five teams playing. He stated that if there are less than 5 teams playing everybody's lineup looks the same so there is no real potential to get ahead or have an advantage.

Information Gathering

Our second research question asked about the methods that people used to gather their player information. Participants in our study expressed how the availability of information at any given time on their mobile devices has enhanced their involvement with daily fantasy sports and their seasonal leagues. All participants confirmed that they used a combination of methods like laptops, mobile devices, and physical newspapers to collect viable player information.

Two–thirds of the participants in the study confirmed that they utilized search engines like Google and Yahoo to do their initial player research. More than half of the participants also found it useful when their research included viewing sports networks like: ESPN, SportsCenter, NFL Network, Fox, NBC, and CBS. They stated that they viewed online game highlights, live stream fantasy sports shows and YouTube.

One-third of the participants reported that they also did some reading during their research periods. They readings included: sports articles, college and professional sports magazines, local newspapers, online sports articles and online sports magazines. Less than half of these same participants browsed through sports forums, Twitter and Reddit posts for player information and updates.

Peter summarized it to "checking on that player any which way you can. Whether it would be just Googling his name to see if anything has come up about him … basically what it's like, it's like being a full time stalker for these players."

Sports Websites

Participants stated that by having access to player information via the sports sites like ESPN, SportsCenter, NFL Network, Fox, NBC, and CBS it made the research more sports specific and gave statistical insight to the players in a team setting. It also gave the participants the opportunity to view specific player clips that are being highlighted on these sites.

Sarah, a 40 year-old female that has been participating in DFS for 2 years, informed that she and her boyfriend watch CBS, FOX and NBC sport networks to see the commentator shows and go online to do their research together.

Penny said that she goes onto NFL.com and does reading to research player stats and injury information "Hoping that something will catch my eye that will tell me 'Oh yeah this will be a really good pickup' or 'avoid this particular pick right here.'"

Fantasy Sports Websites

Websites that were specifically about playing fantasy sports also served as information portals. Participants in the study pointed out that the structure and interface ease of usage was one of the leading factors that led them to return to the same research sites during their information seeking periods. Some of the factors that were mentioned included not only the interface but also flexibility, the ability to track prior contest history, comprehensive information and lineup algorithms.

Several participants noted that compared to general sports sites such as ESPN, which required "digging around forever," fantasy sites his history of past plays and information in a single interface so he didn't have to jump from page to page.

Vic, a 34 year-old male that has been participating in DFS for 2 years and traditional for 12 years, states that Yahoo give him statistical information through their forecasts and game by game breakdowns that helps to aid him in choosing which players he will play in his lineup. "I mean everything is literally right there. And the projections; there's actually a projection, a week by week projection that updates as the season is played on how many fantasy points any player will accrue for the upcoming games."

One-third of the participants said that they received notifications on their mobile phones and laptops which led them to do further research or make modifications to their lineups. Sheldon said that he mostly received projection updates for trades and injuries. When time permitted he would read them and do further research and make changes if needed in his lineup.

While participants agreed that the design of the site was important in their preference of fantasy sports sites, they had different opinions on which sites had a better design. Some preferred sites like FanDuel that had a more simple design, whereas others preferred more information-heavy interfaces such as DraftKings.

While new and more casual players liked that fantasy sports sites were a "one-stop shop" veteran players and more competitive players said that they would prefer utilizing other platforms to get their information so that they could rely on their own judgment and experiences as opposed to the third party research tools and lineup optimizers hosted on fantasy sports sites.

Derrick, who used to use the third party site RotoGrinder but no longer did so, said that he wanted to take a proactive role in information seeking:

> *"You start to realize that this is like any other business or like any other thing in life, this is about money; this is competitive; these people are not out there to give you their tricks to sell the farm in a sense, you know; they are not there to give you their secrets. And so you are sheep sitting there listening to them and you want to move away from that and want to develop what they have developed for yourself."*

Joshua, a 37 year-old male what has been playing for 3 years, advised he has never used third party sites and explained why "No because I figure other people are doing that too so how is that going to give me an advantage."

Other People's Recommendations

While we thought that participants would be secretive about information so they could perform better than others, we surprised to find that many participants were quite open about sharing information with their friends if that could improve their performance:

Helena describes how she interweaves these factors together in her information-collecting:

> *"I would ask my friends who have been experienced in this for longer than me; which ones are good to choose for my lineup and, um, you know, which ones have performed better versus worst, like that's a big deciding point. It is all part of my research, so it definitely plays a big factor. It's like bounce ideas off each other or just brainstorm together or share something new that I might have read that looks interesting."*

Arthur, a 29 year-old male that has been participating in DFS for 2 ½ years, spoke about the discussions that he and his friends have during the season. "With my friends, sometimes we'll talk about who we like, you know, and especially about football who we think is going to beat us. Yeah we just talk about it and then kick around different strategies, maybe debate on who we think's going to do better."

Sarah plays DFS with her boyfriend and together they do the research and decide together on who they are going to put in their lineups. She spoke about how they utilize the apps on his mobile phone in conjunction with their computer to compile information regarding player to help them focus on key players and narrow down together on who they are going to play in which lineups.

Hector stated that he and his friends that play DFS communicate regularly during the season "we're into information sharing, we're looking to gain extra insight that we can. During the season we are usually complaining or gloating about performance; complaining about injuries. Complaining or gloating about a good selection."

Rollin frequently communicates with a fellow computer gamer that he has been playing with since 2005 and who introduced him to DFS: "We do have each other's phone numbers and text, also we have an application called Steam, it's like for gaming, and it's like a chat application. We are just talking about how teams play and kind of talking trash."

Social Media

Multiple participants advised that they utilized YouTube highlights to view the game play of particular players they were interested in or had in their lineups. These participants took this time to get a better understanding of how that player performed against different teams and with their fellow teammates.

Several participants used social media to listen to or read about other players' opinions. Donnie stated that he searches online reviews and frequents sports forums just reading whatever he can since he says that these are his primary sources of information regarding players. Paul stated that even though he has the NBA League Pass to watch the Sixers; he still watches YouTube on a regular basis for everything else sports related. He primarily watches highlight clips and sports shows, but he also watches a YouTube channel that stars two guys who he thinks are pretty good at giving advice on certain players and which ones to put in your fantasy league.

Deciding who to follow on social media, however, also came with its own research. Helena said that she did not want to get "blindly involved" and thus looked up statistics of DFS players who were playing live to help narrow down her choices.

Participants also used online forums, Twitter, and Reddit to gain up to the minute information on players and game stats from the commentators they were following and using this information along with other research to make their final decisions on who to play that day or for the next contest.

James stated: "Twitter is a very quick way to get up to date and accurate information from various sources out there that will help you finalizing or constructing a lineup."

Rollin said that he utilized Reddit to add to his player information seeking. "I'll go on Reddit to like read about specific players. I'll just see what's going on like anything like, any criminal charges or any injuries…family problems or a week off."

Howard spoke about his use of sports forums while researching "I'm just reading it mostly and I'm comparing it to what I got for my lineup at the moment and I make, I might make a lineup change based on what I'm reading."

Information organization and application

Our third research question asked participants about their organization methods and information application. More than half of the participants stated that they use their DFS sites for organization because it shows the contest history of which players they used and their stats. Multiple participants stated it's easier because everything is right there on the site. However, 8 participants had additional ways of organizing their player information which included saving things like posts, articles and even emails.

Spreadsheet

The most prevalent method of information organization was Excel spreadsheets (seven people).

Donnie stated that he literally saves everything that he sees as important information to his laptop's hard drive and then eventually to an external hard drive. He saves articles, posts, and Microsoft Excel spreadsheets that he systematically orders in a way that he can easily access the information at any given moment.

Derrick said that he uses Excel via an open server because as he states "it gives you more options" and for stats using his own root a matrices for calculations to aid in filtering out all the restraints each site that he uses has on players according to their rules so he can make a determination on which ones to play for a specific contest entry.

Sarah that she and her boyfriend use Excel to store their research information and believes that it aids in their strategy: "I think so, yes because we're keeping track of our players each week and I think it helps us… it's right there in front of us; it's easy to change their stats week by week and we can even keep it, you know, and put it right next to them each week."

Joshua stated that he does not save his information using Excel but he goes to different websites to review numbers and statistics of players and "those websites usually have spreadsheets full of all kinds of information that you are looking for. So they are kind of there for you, you just have to go look at them."

Email and Paper

Two people said that they utilized email to save information about players. They save news articles, stats and emails from sports sites. Helena said:

> *"It's very simple really; I mean I don't get very elaborate with it. I use just a word document where I would paste some links and I would have like specific team names and specific player names and then just have like a bunch of links under that and I could refer back to it… if it's something interesting that I figured would help me in the future, I save it. I like email it to myself and I save it in my email. I might either email myself a link or email myself like a screenshot or an actual article; like I will copy and paste the text, if it has some tables or some stats that might disappear over time. Um, so I do use email I just figure that's like the best repository for me because this way I can retrieve it in the future and I find it most convenient."*

Castor also saves emails and that this was the best method for him since he can be forgetful at times.

While most participants used some kind of digital tool to record and organize their information, Mark was an exception because when he does his research throughout the day he is writing down whatever he finds in his notebook, whether it's important or not so that he can have it as a reference point to look back on when he is doing his lineup.

DISCUSSION

We found that numerous factors influence people's decisions about how to form their lineups, but that it breaks down into three stages: information collection, assessment, and verification. The information collection phase can be both quantitative or qualitative. A quantitative approach, based on statistics, involves objective facts about the athletes that the users are interested in, including performance history. A qualitative approach is based on feelings of connectivity or self-assessments of sports players' personality and character.

After assessing this information and building a "draft" lineup, we found that many DFS players tried to verify or test their lineups by running simulations and using external tools to validate or improve their picks. These three phases formed an iterative cycle.

When it comes to informational resources and organization, it was clear that no single platform provides DFS users all the tools that they need in one place. Some were using specialty sites to help with their decision-making, such as the type of system described by Solomon [34]. However, especially for users who are more experienced DFS players, they created an ecosystem of hacked-together tools and resources to maximize their chances of winning. Also, no single information source was enough—players used a variety of sources and source types to triangulate data points and get a holistic view of the sports players they were interested in.

We also found that context matters, because players' decision to participant in a contest or not revolved around situations in their own lives such as financial means and ability to view the games, as well as game-specific situations, such as how many games were taking place in a given day.

Design Implications

Intense and casual users had different information gathering practices. Casual users liked having everything in one place, whereas players with higher stakes preferred to investigate a myriad of information. This suggests that the interface of DFS systems should be customizable so players can decide which suite of tools and/or information they

want and that even if DFS sites should serve as an information portal, they could benefit from letting the players choose their information sources. At the same time, too many customization options may be overwhelming for the casual user, so the site default should be minimal and simple, with the option to add features, like widgets.

While DFS sites already archive players' past lineups, we found that the ability to archive research information was also important for players. Adding features that support systematic and searchable forms of information storage may increase engagement on the site. Incorporating bookmarking features that are commonly used in scholarly article reference systems, that enable users to save "clippings" of articles in a systematic way and be able to search one's own archive of curated information could be useful to players.

Playing DFS is arguably inherently social because one is competing with other players, but we found that for many participants, playing DFS was also a collaborative activity. Our participants—especially those whose primary motivation was not making money—were generally open to sharing information with others and, in the case of couples, made decisions together. Participants were also using social media to see others' thoughts and engage in discussions with people that they did not know. This presents an opportunity to incorporate more communication and social features into DFS sites, as current DFS sites are designed more for the individual player.

Limitations

We had some limitations in terms of sampling, as users were recruited through Mechanical Turk and the Yahoo VIP list. Thus the people we interviewed were more likely to be technically savvy than the average person.

The self-identified daily fantasy sports players that we interviewed were also most likely people who enjoyed playing, as evidenced by the fact that many had been playing fantasy sports for years. Among our participants, the least amount of time spent on research per week was five hours, reflecting intense research practices. It is unclear if this sample is representative of all DFS players, although the average time they spent doing research were similar to national surveys.

CONCLUSION

In this study, we interviewed players of daily fantasy sports to understand their information-seeking and decision-making behaviors. As a unique type of pervasive play that incorporates both real-world sporting events that augmented by data analysis, information collection, and social interactions, DFS was an unique context in which we could understand how people navigate this complexity. We found that players of DFS see being successful at DFS as not entirely up to chance and spend much time collecting and assessing information to increase their chances of winning through a variety of social and technologically-mediated research practices.

Due to the rapid cycle of decision-making that is required to play daily fantasy sports, we found that participants engaged in sophisticated and complex methods of information compilation and evaluation, using a wide range of digital and analog tools as ad-hoc decision support systems to help them organize vast amounts of information in a short amount of time. Data analysis, however, was not just about statistical modeling; we found that qualitative assessments mattered just as much as quantitative ones and that no one tool suited the needs of a player, which resulted in a wide variance of practices across individuals.

ACKNOWLEDGEMENT

This study was funded in part by the Yahoo Faculty Research Engagement Program.

REFERENCES

1. June Ahn, Elizabeth Bonsignore, Derek L. Hansen, Kari Kraus, and Carman Neustaedter. 2016. Pervasive Play. *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '16)*, ACM, 3317–3324.

2. David Arnott and Graham Pervan. 2014. A critical analysis of decision support systems research revisited: the rise of design science. *Journal of Information Technology* 29, 4: 269–293. http://doi.org/10.1057/jit.2014.16

3. Pratyush Bharati and Abhijit Chaudhury. 2004. An empirical investigation of decision-making satisfaction in web-based decision support systems. *Decision Support Systems* 37, 2: 187–197. http://doi.org/10.1016/S0167-9236(03)00006-X

4. Andrew C. Billings and Brody J. Ruihley. 2013. Why We Watch, Why We Play: The Relationship Between Fantasy Sport and Fanship Motivations. *Mass Communication and Society* 16, 1: 5–25. http://doi.org/10.1080/15205436.2011.635260

5. Andrew Billings, Brody James Ruihley, and Yiyi Yang. Fantasy gaming on steroids? Contrasting fantasy sport participation by daily fantasy sport participation. *Communication & Sport*. http://doi.org/10.1177/2167479516644445

6. James Bonner and Clinton J. Woodward. 2012. On domain-specific decision support systems for e-sports strategy games. *Proceedings of the 24th Australian Computer-Human Interaction Conference on - OzCHI '12*, ACM Press, 42–51. http://doi.org/10.1145/2414536.2414544

7. Jon Boswell. 2007. Fantasy Sports: A Game of Skill That Is Implicitly Legal under State Law, and Now Explicitly Legal under Federal Law. *Cardozo Arts & Entertainment Law Journal* 25. Retrieved September

21, 2016 from http://heinonline.org/HOL/Page?handle=hein.journals/caelj25&id=1263&div=&collection=

8. V. Braun and V. Clarke. 2006. Using thematic analysis in psychology. *Qualitative research in psychology* 3, 2: 77–101.

9. Marcus Carter, John Downs, Bjorn Nansen, Mitchell Harrop, and Martin Gibbs. 2014. Paradigms of games research in HCI. *Proceedings of the first ACM SIGCHI annual symposium on Computer-human interaction in play - CHI PLAY '14*, ACM Press, 27–36. http://doi.org/10.1145/2658537.2658708

10. Brenda Dwyer and Yongjae Kim. 2011. For love or money: Developing and validating a motivational scale for fantasy football participation. *Journal of Sport Management* 25, 1: 70–83. Retrieved October 16, 2015 from http://www.humankinetics.com/AcuCustom/Sitename/Documents/DocumentItem/07 Dwyer_jsm_2009_0178.pdf

11. Gabriel S. Dzodom and Frank M. Shipman. 2014. Data-driven web entertainment: the Data collection and analysis practices of fantasy sports players. *Proceedings of the 2014 ACM conference on Web science - WebSci '14*, ACM Press, 293–294. http://doi.org/10.1145/2615569.2615649

12. Gabriel Dzodom and Frank Shipman. 2016. Data-driven Prediction Games. *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '16)*, ACM, 1857–1864.

13. John Eighmey and Lola McCord. 1998. Adding Value in the Information Age: Uses and Gratifications of Sites on the World Wide Web. *Journal of Business Research* 41, 3: 187–194. Retrieved from http://www.sciencedirect.com/science/article/pii/S0148296397000611

14. David Elsweiler, Stefan Mandl, and Brian Kirkegaard Lunn. 2010. Understanding casual-leisure information needs. *Proceeding of the third symposium on Information interaction in context - IIiX '10*, ACM Press, 25. http://doi.org/10.1145/1840784.1840790

15. Lee K. Farquhar and Robert Meeds. 2007. Types of Fantasy Sports Users and Their Motivations. *Journal of Computer-Mediated Communication* 12, 4: 1208–1228. Retrieved September 23, 2015 from http://doi.wiley.com/10.1111/j.1083-6101.2007.00370.x

16. FTSA. 2016. Indusrty Demographics At A Glance. *Fantasy Sports Trade Association*, 3–5. Retrieved from https://fsta.site-ym.com/?page=Demographics

17. Amitava Ghosh and Ambuj Mahanti. 2014. An information system for investment advisory process. *Proceedings of the International Conference on Information Systems and Design of Communication - ISDOC '14*, ACM Press, 143–148. http://doi.org/10.1145/2618168.2618191

18. Sandra Hirsh, Christine Anderson, and Matthew Caselli. 2012. The reality of fantasy: Uncovering information-seeking behaviors and needs in online fantasy sports. *Proceedings of the 2012 ACM annual conference extended abstracts on Human Factors in Computing Systems Extended Abstracts - CHI EA '12*, ACM Press, 849. http://doi.org/10.1145/2212776.2212858

19. Jenna Hartel. 2003. The Serious Leisure Frontier in Library and Informtion Science: Hobby Domains. *Knowledge Organization* 30, 3/4. Retrieved from https://works.bepress.com/jenna_hartel/32/

20. Jay Caspian Kang. 2016. How the Daily Fantasy Sports Industry Turns Fans Into Suckers - The New York Times. *The New York Times Magazine*. Retrieved April 13, 2016 from http://www.nytimes.com/2016/01/06/magazine/how-the-daily-fantasy-sports-industry-turns-fans-into-suckers.html?_r=1

21. Adam Krejcik. 2015. *Daily Fantasy Sports Player Survey - 2015*.

22. Markus Montola, Jaakko Stenros, and Annika Waern. 2009. *Pervasive games: theory and design*. Elsevier/Morgan Kaufmann, Amsterdam, Boston.

23. Louis S. Nadelson, Christina M. Sias, Joshua Matyi, et al. 2016. A World of Information at Their Fingertips: College Students' Motivations and Practices in Their Self-Determined Information Seeking. *International Journal of Higher Education* 5, 1: 220–231. http://doi.org/10.5430/ijhe.v5n1p220

24. Nico Newman. 2015. History of Fantasy Sports. Retrieved April 13, 2016 from https://fantasy-sport.net/history-of-fantasy-sports/

25. John W. Payne and James R. Bettman. 2002. Preferential choice and adaptive strategy use. In *Bounded rationality: The adaptive toolbox*, G. Gigerenzer and R. Selten (eds.). MIT Press, Cambridge, MA, 123–145.

26. PDFS. 2015. What is Daily Fantasy Sports? 3–5. Retrieved from http://www.playdailyfantasysports.com/what-is-daily-fantasy-sports/

27. Richard G. Lomax. 2006. Fantasy sports: History, game types, and research. In *Handbook of Sports and Media*, Arthur A. Raney and Jennings Bryant (eds.). Lawrence Erlbaum, 416–425. Retrieved from

https://books.google.com/books?hl=en&lr=&id=SWyNAgAAQBAJ&oi=fnd&pg=PA416&dq=daily+fantasy+sports&ots=A8R10SRC88&sig=qRFQYbVCvCf8XNA8ol_WvWJZkTs#v=onepage&q=daily fantasy sports&f=false

28. Brody J. Ruihley and Andrew C. Billings. 2013. Infiltrating the boys' club: Motivations for women's fantasy sport participation. *International Review for the Sociology of Sport* 48, 4: 435–452. http://doi.org/10.1177/1012690212443440

29. Brody J. Ruihley, Andrew C. Billings, and Coral Rae. 2014. As time goes by: Deciphering the fantasy sport playing teenager. *Sport Marketing Quarterly* 23: 187–197.

30. Reijo Savolainen. 1993. The sense-making theory: Reviewing the interests of a user-centered approach to information seeking and use. *Information Processing & Management* 29, 1: 13–28. http://doi.org/10.1016/0306-4573(93)90020-E

31. Reijo Savolainen. 1995. Everyday life information seeking: Approaching information seeking in the context of "way of life." *Library & Information Science Research* 17, 3: 259–294. http://doi.org/10.1016/0740-8188(95)90048-9

32. Frank M. Shipman. 2009. Blending the real and virtual in games. *Proceedings of the 4th International Conference on Foundations of Digital Games - FDG '09*, ACM Press, 169. http://doi.org/10.1145/1536513.1536547

33. Brian Smith, Priya Sharma, and Paula Hooper. 2006. Decision making in online fantasy sports communities. *Interactive Technology and Smart Education* 4: 347–360.

34. Jacob Solomon. 2014. Customization bias in decision support systems. *Proceedings of the 32nd annual ACM conference on Human factors in computing systems - CHI '14*, ACM Press, 3065–3074. http://doi.org/10.1145/2556288.2557211

35. Amos Tversky and Daniel Kahneman. 1973. Availability: A heuristic for judging frequency and probability. *Cognitive Psychology* 5: 207–232.

36. Yunfeng Zhang, Rachel K.E. Bellamy, and Wendy A. Kellogg. 2015. Designing Information for Remediating Cognitive Biases in Decision-Making. *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems - CHI '15*, ACM Press, 2211–2220. http://doi.org/10.1145/2702123.2702239

37. The History And Evolution Of Fantasy Sports. Retrieved April 13, 2016 from http://futureoffantasy.com/the-history-and-evolution-of-fantasy-sports

38. How the Daily Fantasy Sports Industry Turns Fans Into Suckers - The New York Times. Retrieved April 13, 2016 from http://www.nytimes.com/2016/01/06/magazine/how-the-daily-fantasy-sports-industry-turns-fans-into-suckers.html?_r=1