Aspiration and Survival in "Jeopardy!"

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Abstract

Behavior in dynamic competitive situations requires decision makers to evaluate their own as well as their competitors' positions. This paper uses data from a realistic competitive risk taking setting, *Jeopardy's* Tournament of Champions, to test whether individual players choose the strategic best response in making their betting decisions. The analyses show that the percentage of players choosing the strategic best response is very low, a rather surprising finding because the Tournament of Champions is contested by the very best and most experienced players of the Jeopardy game. We conjecture that performance aspiration and survival targets guide risk-taking behavior in competitive situations. Furthermore, in situations where decisions are made under pressure, contestants tend to focus on one target while ignoring alternative targets and the choices that are available to their competitors. This may lead them to select inferior competitive strategies.

Key Words: Competitive Decision-Making, Decision Theory, Risk

A major assumption underlying economic analysis is that in attempting to maximize one's utility agents are affected by incentives. Furthermore, since a substantial part of economic activity takes place in competitive situations, it is assumed that economic agents pursue their interests in such situations in a rational manner, that is, they collect the relevant information and process it properly. Checking whether agents behave as assumed is not an easy task. Many experimental studies were conducted to examine several aspects of rational behavior but even though such experiments are well designed they lack in not being able to offer significant incentives to the subjects. There is interest therefore in examining the behavior of economic agents in real competitive situations. One setting that offers such an opportunity is television game shows where substantial rewards are offered to the winners. One such show is the Jeopardy! Game, which is the longest running general knowledge quiz show in the United States. Over 17 million loyal fans tune in to see who will win an average of $11,500 each game.

Nalebuff (1990) challenged economists to come up with advice to contestants about how to bet in the last question in the Jeopardy! game and Metrick (1995) examined data from regular shows of the game. Metrick (1995, p. 252) concludes that while most of the players in his sample bet in a rational manner, some puzzling aspects in their behavior could not be accounted for. First, many "fail to notice that a specific option is available." Second, "Suboptimal choice can persist despite the three mitigating factors of high stakes, an identifiable market mechanism, and an opportunity for players to learn." Metrick argued that the most important of these mitigating factors is the market mechanism that plays a major role in driving out inferior players.

We follow Metrick's reasoning and extend his analysis to examine the betting behavior of the very best and most experienced set of the players of the Jeopardy! Game. These are the players who participate each year in Jeopardy's Tournament of Champions (TOC), which is the apex of the season. Fifteen players participate in the TOC each year. Thirteen of them qualify for the TOC by winning 5 consecutive games in the regular season. The other two players qualify for the TOC by winning the College or Teen tournament held in the previous year. The player winning the TOC is awarded $100,000. The second and third place players receive $15,000 and $10,000 respectively. The TOC fits Metrick's market mitigating factors nicely. The stakes are the highest in this game; the market mechanism is more identifiable than the regular season since the players are selected from all contestants, over 500 of them, who played the game during the whole year. They learn from the five games they participated in during the season and they prepare meticulously for the TOC once they are told that they will compete in it.

The TOC is played in three stages-- qualifying, semi-final and final. The qualifying stage determines which 9 players advance to the semi-finals. The qualifying stage consists of five games, each played by three players. Five players qualify for the semi-finals by winning their game. Four additional players progress to the semi-finals by qualifying for a "wildcard" slot. These four players have the highest scores amongst those players who did not win their game. Three games are played in the semi-final stage and the winner of each game advances to the finals, which are played cumulatively over two consecutive games.

Like Metrick (1995) we focus on the Final Jeopardy question. In Final Jeopardy (FJ) the players are shown a single category from which they are asked one question. All players answer the same question, which is presented to them simultaneously and they write down their answers simultaneously. The players know only the category but not the specific question before they decide how much to bet. They know their own score as well as the scores of the two other contestants before betting. Players cannot bet more than their score or less than zero. If a player answers correctly the bet amount is added to his/her score. If the player answers incorrectly the bet amount is subtracted from his/her score. During a regular season game (not a TOC game) the player with the highest score after FJ gets to keep the money they have won and return to play another game with two new competitors on the next show. The other two players get only a consolation prize. In contrast, in the first stage of the TOC, which is the qualifying round, players do not get to keep any of their winnings. They are playing only for the opportunity to advance to the semi-finals. Therefore, their score is used solely for the purpose to select who gets into the next stage, where all scores are set to zero. Each player must decide whether they are going to try to win their game or whether they are going to try to qualify for one of the four-wildcard slots. Our study focuses on the FJ question in the qualifying stage. The paper is structured as follows: In the next section we describe the data and present descriptive statistics. In Section II we describe the strategic best responses available to the participants. In Section III we analyze the players betting behavior and in section IV we analyze the participants' responses in light of the targets they have. Section V concludes.

I. Data and descriptive statistics

Our data include the FJ bets made by all players in the qualifying round (55 games) of the eleven TOCs staged by the show between 1990 and 2001.[1] We excluded 7 of the 55 games played because in these games the first place player has already won the game before the start of FJ. These games are often referred to as "runaway games" (Metrick, 1995) because the first place player's score is more than double that of the second place player. In this case the first place player can be assured of winning the game with a zero bet. We exclude these games because the first place players do not have any decision to make and the second place players can only strive to qualify for a wildcard position in the semi-finals. In addition, we focus in our analyses only on players in

[1] Jeopardy! was first aired in 1964 and ran until 1975 and the host was Art Flemming. Jeopardy! aired again in 1978 for one year. Then in 1984 the show began its current run with Alex Trebeck as host. We have data for 1990 onward because the show changed producers in 1990 and the old records have apparently been lost.

first and second place because the majority of players in third place cannot win the game and therefore do not have to make the kind of decision of interest in this paper.

Betting to Win the Game.

The players in first place prior to the FJ round win 35 (72.9%) of the 48 games. The players in second place win 10 games 20.8% and players in third place win 3, or 6.3% of the games. Winning the game is a function of those players who answer the FJ question correctly and the amount each player bets. There are eight possible combinations of correct/incorrect answers among the three players (see Table 1). The first, second and third place players answer the FJ question correctly in 62.5%, 50.1% and 48.0% of the games, respectively. The most frequent combination of responses is all three players answering correctly (27.1%). The second most frequent combination is that all three players are wrong (18.6%) and the third most frequent combination is a correct answer by the first place player and wrong answers by the other two players (16.7%).

Insert Table 1 about here

The frequency of bets made by the players in first place is shown in Table 2. The data in the table is organized around what the players refer to as the "shutout" bet. The shutout bet ensures that the player in first place wins the game if he/she answers correctly even if the second place player bets all of their assets and also answers correctly. For example, if the scores before FJ are 10,000 for the player in first place and 6,000 for the player in second place, the shutout bet is 2,001. The highest score that the second place player can reach is 12,000 and when the first place player bets 2,001 (i.e., the shutout bet) and answers correctly her final score is 12,001 and she wins the game. The first place player bets to shutout the second place player in 21 (43.8%) of the games.

Another nine (18.7%) bets were close to the shutout bet, most within 100 of it. Eighteen bets (37.5%) were in amounts lower than the shutout bet.

Insert Table 2 about here

Table 3 presents the frequency of bets made by the second place players. These bets are also organized around the shutout bet but in a different way. The second place player can only win the game if the first place player answers incorrectly and bets an amount that would reduce their final score below the final score of the second place player. Following this logic and assuming that the first place player bets the shutout bet, a second place player should bet an amount that would result in a final score greater than the first place player's score minus the shutout bet. Metrick (1995) referred to these bets as "Low" bets, while he categorized larger bets as "High." The second place players bet Low in 19 (38%), High in 14 (28%) and Zero in 2 (4%) of the games. Eleven of the players in the remaining games bet all of their assets (22%) and four (8%) others bet amounts within 200 of their total assets (see Table 3). Note that since in two games, two players were tied before the FJ bet, the number of decisions by second place players in Table 3 is 50.

Insert Table 3 about here

Betting to Qualify for a Wild Card Slot.

Figure 1 depicts the probability of progressing to the semi-finals for scores ranging from zero to 10,000[2]. As Figure 1 shows that the probability of advancing to the semi-finals increases

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Insert Figure 1 about here
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[2] This analysis is based on the scores among non-winners because non-winners are the only players that can qualify for a wildcard slot.

dramatically between 7,500 and 8,000. The figure shows that the probability that a player would qualify for the semi-finals with a score between 0 and 2000 is zero. All players with scores greater than or equal to 10,000 have advanced to the semi-finals. The probability of a player qualifying for the semi-finals jumps from 50% to 80% with just a 500-point increase in score from 7,500 to 8,000. An additional 1,000 increase in score, for a total of 9,000, raises a player's chance of qualifying by only 10%. Therefore, we estimate that the threshold for qualifying as a wildcard is 8,000. Evidence that the players have this dollar figure in mind as the amount needed to qualify for a wildcard slot is provided by comments made by Jeopardy contestants scheduled to compete in the 2001 TOC (TOC Report, 2001). One of the contestants said the following about preparing for the TOC:

> *"A couple of strategy points, for those who might be interested. Going into the game, I figured it would take a minimum of 8,000 to advance to the next round."*

III. Strategic Best Response

We now examine the ability of players to bet the strategic best response in the qualifying round of the TOC. We define the strategic best response as the FJ bet that has the highest probability of advancing the player to the semi-finals. Recall that the dollar amounts that the players accumulate in the qualifying stage are irrelevant if they win the game. In this case they advance to the next stage regardless whether they have a high or low final score. If they do not win the game but compete for the wildcard, the amount they accumulate is relevant only in a relative sense, that is, relative to the scores of other players who did not win their games. Recall also that the players do not get to keep any of those amounts. Everything starts from scratch at the next stage. Therefore, the only issue of concern is the probability of advancing to the semi-finals.

This probability depends on two variables: The player's score before he/she makes the FJ bet, and the chance that they will be correct in answering the FJ question. The data we use for examining the strategic best response is based on the aggregate data available to us (and to the contestants). In line with the data portrayed in Figure 1 we consider two cases in determining the strategic best response: a) players with scores greater than or equal to 8,000; and b) players with scores below 8,000. The reason for selecting 8,000, as the cutoff point for the analysis is the dramatic increase in the probability of qualifying for the semi-finals as described in Figure 1. If a player has 8,000 he/she has a very high chance of qualifying for the semi-finals. They can increase this chance by having a higher score but betting to get a higher score is mitigated by the probability of being correct on the FJ question. Overall, a player who has 8,000 and bets 500 can increase their chance of qualifying by only 5%. However, if they are wrong and lose 500 their score drops to 7,500 and the chance of qualifying drops by 30%. In addition, as mentioned earlier, the probability of being correct on the FJ question, regardless of one's score, is lower than 80%.

The asymmetry around the 8,000 points informs our analysis of the strategic best response. Furthermore, we assign no special value to winning the game (even though the players might) except that it ensures qualifying for the semi-finals. Thus, when considering a bet to win the game the player should take into the account the negative consequences of being incorrect on the FJ question. The former can ensure getting to the next stage; the latter can lead to being eliminated from the TOC.

Players with scores greater than or equal to 8,000

For first and second place players with scores greater than 8,000 the strategic best response is to bet zero because if they bet to win, their probability of winning the game is lower than the probability of advancing to the semi finals as a wild card (80%).

Betting any positive amount can only reduce a player's chance of qualifying for the semi-finals because the probability of correct response is only 62.5% for first place players, which is less than 80% chance of qualifying as a wild card while betting zero. Players in the first place with scores above 8,000 win 76.7% of these games. Among players in the first place, three who bet non-zero amounts, failed to win the game but succeeded in qualifying for the semifinals as a wild card. Three other first place players and one second place player, who bet non-zero amounts failed to win, did not succeed in getting a wild card slot and were eliminated from the TOC. The decision is even starker for players in second place. The second place player has only a 10% chance of winning and only a 50.1% chance of answering the FJ correctly. Thus, the bet with the greatest odds of advancing either player is zero when their score is above 8,000.

Players with Scores Below 8,000

When a player's score is below 8,000, both the first and second place player should bet everything they have. This recommendation reflects the data in Figure 1. In this situation the first place player only wins 61.1% of the games and the player in second place wins only 22.2%. When a player has less than 8,000 their best chance of qualifying for the semi-finals is to reach or exceed this threshold. For example, if a player has 6,000 they only have a 47% chance of qualifying for the semi-finals. By betting the entire 6,000 and answering correctly the player would have a score of 12,000 and a 100% chance of qualifying for a wildcard slot. If the same player bets 2,000 he/she would have either 8,000 (80% chance of qualifying) or 4,000 (10%

chance of qualifying). By not betting their entire score the player reduces their chances of qualifying by from 47% to 10% without maximizing the upside probability of qualifying for the semi-finals. We do want to emphasize that the situation is somewhat less clear for players with scores between 7,000 and 8,000. For instance, if a player has 7,000 and bets 1,000 she increases her odds of qualifying for a wildcard slot by 30% (if she is correct) while only minimally decreasing her chances of advancing (by 4.6%) if she answers incorrectly. We could define a strategic best response for small intervals around players' scores but the analysis would be much more cumbersome. The gist of the strategic analysis we believe is to construct two generic strategies around the 8000 mark. Of course, individual players make their own analysis and can bet according to their specific scores and beliefs.

III. Analysis of Players' betting behavior

Bet size

To describe the actual bets made by players in the TOC we follow the approach used by Metrick (1995) and classify the bets into four groups—Zero, All, High, and Low. Betting Zero or All of one's assets is self-explanatory. The definitions of High and Low vary by a player's position. Players in first place that make a shutout equivalent bet are considered to have bet High. First place players not betting Zero, All, or High are considered to have bet Low. Players in second place are considered to have bet Low when they bet so that their score will be high enough to win the game if the first place player bets the shutout bet and answers incorrectly. For example, suppose the first place player has 8,500 and the second place player has 6,000. If the second place player bets an amount between 0 and 999, the bet is classified as Low. In this case the shutout bet is 3,501. If the first place player made this bet and answered incorrectly his/her score final score would be 4,999. If the second place player bet an amount between 0 and 999 they would win the game. Second place players not betting Zero, All, or Low are considered to have bet High.

Analysis of First Place Players Bets

In 30 of the 48 games (see Table 4) the score of the first place player was above 8,000. Only one of these players bet Zero, which is considered the strategic best response. This player also won the game. Fourteen of these players bet Low, and 11 of them (78.6%) won the game and 15 bet High and 12 of them (80%) won the game. Four of these players did not win the game but qualified for the semi finals. Altogether, three players in this condition were eliminated from the TOC. In eighteen of the games the score of the first place player was below 8,000. None of these players bet All which is the strategic best response. Three players bet Low and 15 bet High. Overall, only one (2.1%) of the first place players bet the strategic best response. Eleven of the eighteen first place players won their game, three qualified for a wild card slot, and four were eliminated from the tournament.

Insert Table 4 about here

Analysis of Second Place Players Bets

Our data set includes bets made by 50 players in second place due to two ties. Ten of these players had a score above 8,000. One player bet All and nine bet Low (see Table 4). Two of the players won their game (20%), and seven qualified without winning (70%). None of these ten players bet Zero, which is considered the strategic best response. Forty players had a score below 8,000. Fourteen players bet All, the strategic best response, two bet Zero, fourteen bet High and ten bet Low. Overall, fourteen (28%) of the second place players can be said to have bet the strategic best response. Eight of these 40 players won their game (20.5%) and thirteen of the 40 (32.5%) qualified without winning their game.

We were somewhat surprised to see how few of the players bet the strategic best response. To investigate this finding we first examine each bet to see if our definition of the strategic best response should be expanded by looking at specific games. We identify one situation in which the bet of a first place player could be considered a strategic best response. In this situation the first place player could shutout the second place player by betting a small amount that would not reduce the first place players score below 8,000 if he/she answered incorrectly. Three players made this type of bet: One had 12,900 and bet 1,001, the second had 9,800 and bet 1,001 and the third had 8,800 and bet 801. While these three bets are not as poor as the rest, the strategic best response for them would still be to bet zero.

We also identify an additional situation in which the bets of a second place player could be considered a strategic best response. In this situation the player in second place only had to bet a small amount to ensure that their score would be higher than the first place players score minus the shutout bet. For example, such a situation would arise if the first place player had a score of 9,500 and the second place player had a score of 6,000. In this situation the shut out bet is 2,501. If the first place player answers incorrectly their final score would be 6,999. By betting 1,000 the second place player could win the game if he/she answered correctly and the first place players did not. However, in actuality none of second place players made this type of bet.

In sum, we find that only 1 first place player (2.1%) and 14 second place players (28%) bet the strategic best response. In the next section of this paper we explore possible explanations for the low occurrence of strategic best responses.

IV. Targets and Betting Behavior

A possible reason for the inability of players to choose the strategic best response is the presence of two alternatives or targets in the FJ stage: Winning the game or trying to qualify for a wildcard slot. The existence of these two somewhat conflicting targets may affect players' behavior when they try to decide which target to focus on. First, players may consider the two targets, flip back and forth and select one that may lead to following an inferior strategy, that is, focus on the wrong target. Alternatively, a player may focus on one target only and as a result may not consider all the available options.

The idea that two targets or reference points affect risky choice was introduced in the variable risk preferences model developed by March and Shapira (1992). They developed random walk models of risk taking where the decision-maker considers two targets: An aspiration level for resources that adapts to experience and a fixed survival point where resources are depleted. Risk taking is essentially a realization of a series of independent draws from a normal performance distribution of possible outcomes. The distribution is assumed to have a fixed mean and a variance that changes in time. Each realization ends with either success or failure that changes the risk taker's resources. The decision maker selects the bet size on every step. Risk taking is controlled by two simple rules: The first rule suggests that when resources are above the focal reference point bet size is set so that in case of failure resources would not fall below the focal reference point. The second rule applies when resources are below the aspiration focal point. In this case bet size is set so that in the case of success resources will surpass the aspiration level. These two rules make risk-taking behavior sensitive to: (1) the risk taker's resources relative to the survival and aspiration points, and (2) whether the risk taker's focus is on the survival reference point or on the aspiration level reference point. Two basic risk functions are plotted in Figure 2. The functions are not utility functions. They show risk taking directly as the standard deviation of the performance distribution. The function that starts at the origin assumes that the risk taker focuses on survival, which is assumed to be fixed. Risk taking increases monotonically with resources. The second function depicts risk taking while focusing on the aspiration level, which is not assumed to be fixed. Thus, there is a family of such functions for different aspiration levels. The two graphs described in Figure 2 are specific functions reflecting particular parameter values and should be viewed as representing a class of models (see March and Shapira, 1992).

Insert Figure 2 about here

The model assumes also that the decision maker's history of success and failure and her/his self-confidence affect the risk they take. In applying the model to the risk taken by the TOC players we assume that they consider the two reference points. In this respect winning the game is the player's aspiration level while obtaining the wildcard slot is the survival point. We hypothesize that in such competitive situations both the aspiration level and the survival point affect risk taking. In addition we propose that focusing on one target in competitive situations, especially when it is done under pressure, may lead to the selection of inferior strategy because of the increased complexity of the decision due to the availability of the two targets. We apply the model to examine the betting behavior of the players in the FJ question of the qualifying stage of the TOC. To analyze their behavior according to the model we conducted regression analyses. We first describe the variables that were included in the regressions.

Dependent variable. The dependent variable (*Bet/Assets*) is the bet amount divided by the player's total assets. By total assets we mean the player's score just prior to the FJ bet. Players who bet all of their assets are assumed to be taking a greater risk than if they bet only

50% of their assets. We do not use the dollar amount of the bet as a risk measure because two players betting 1,000 can be in very different positions in the game. If a player in first place has 10,000, the second place player has 4,000, and they both bet 1,000, the amount of risk taken is significantly different when considering relative competitive positions.

Independent variables. Two important independent variables are the distances from the focal reference points, that is, distance from aspiration level and distance from the survival point. We define these points and the corresponding dependent variables as the distances from them.

> *Aspiration Point*: The aspiration of all players is winning the game. For players in first place, their aspiration point is equal to the second place player's score plus $1. For the players in second place, their aspiration point is the leader's score plus $1.

The primary concern for players in first place is staying above the second place player's score. For the second place players focusing on their aspiration point, their primary concern is closing the gap between their score and the score of the first place player. To reflect this we use, in the following definitions, the difference between the first place player's and the second place player's scores in the model.

> *Distance from Aspiration Point (DAP)*: The difference between the scores of the first and second place players just before the FJ bet.

Survival Point: The variable risk preferences model (March & Shapira, 1992) equates survival point with extinction. In their model extinction is reached when cumulative resources are zero. We modify the model somewhat to fit the competitive situation presented by the qualifying stage of TOC. Players may have positive resources after the FJ round bets get scored but still may not be able to advance to the semifinals and would be eliminated. Therefore, we equate survival with the score a player needs to qualify for a wildcard slot in the semi-finals of the TOC. The survival point is defined in line with our prior discussion.

Distance from Survival Point (DSP): The distance (in absolute amount) of the player's score from the survival point (8,000 just before the FJ bet.

In addition to the distance from the two focal reference points we include three additional independent variables: Correct, Bet Maximum and Focus.

Correct: This variable represents the level of confidence a player has that he/she will answer the FJ question correctly. Correct enters the model as a dummy variable coded 1 for correct answers and 0 for incorrect answers.

Even though this measure is ex-post it arguably reflects players' estimates of their chances of answering the question correctly.

Bet Maximum: In line with the variable risk preferences model we set a control for the fact that players cannot bet more than their total assets. Obviously, it makes no sense whatsoever for the first place players to bet all their assets so the Bet Maximum variable is applicable to the second place players only. We measure bet Maximum using a dummy variable coded 1 if the players bet all of their assets and 0 if not.

Focus: To apply the variable risk preferences model for analyzing players' betting behavior we have to establish whether players were focused on their survival or on their aspiration point. The criterion used to determine whether the first place players were focusing on their aspiration or survival point is based on whether or not they made the shutout bet. If they made this bet we assume they were focused on the aspiration point, otherwise we assume that they were focused on their survival point. If the first place player bets to shut out the second place player they are assured of winning if they answer correctly (i.e. they win even if the second place player answers correctly). First place players not making this bet risk losing the game even if they answer correctly. This can happen if the second place player answers correctly and bets all of their assets. The fact that second place players are correct 50% of the time reinforces the need for the player in the lead to make the shutout bet

The criterion for determining whether players in the second place were focusing on their aspiration or survival point is more complex. We assume that the second place players are focused on their aspiration point if they bet to "win" the game. We operationalize this idea in terms of a player's expected final score. If after answering (correctly or incorrectly) the player would have enough money to win if the first place player had made the shutout bet and answered incorrectly. We assume that all other players in second place are focused on their survival point. Focus is defined therefore as a dummy variable in the model and operationalized as follows: It is set to 1 if players were focused on their aspiration point and 0 if they were focused on their survival point.

In sum, the dependent variable is Bet/Assets. The independent variables are Distance from aspiration point, Distance from survival point, Focus, Correct, and Bet Maximum.

Results

Table 5 reports the regression results. In the regression for players in the first place**,** Distance from Aspiration Point, Focus and Correct are highly significant while Distance from Survival Point is not. In the regression for the second place players, Distance from Aspiration Point, Distance from Survival Point, Bet Maximum, and Focus are all significant while Correct is not. The relatively high R^2 values suggest that the model does a good job in explaining the players' bets. In particular the Distance from the Aspiration Point has a major role in both cases. The fact that Distance from Survival Point is not significant for the players in first place raises a question whether players who are above their aspiration point are either unable to notice the survival point alternative or in some way undervalue the advantage of focusing on this option. It is interesting to note that the only first place player that bet the strategic best response (i.e., Zero) had a score of 13,100 and he also won the game.

Insert Table 5 About Here

The conjecture that focusing on one target (aspiration and/or survival) may lead to inferior strategy selection is supported by the low percentage of players that bet the strategic best response. For example, in season 1, game 4, the first place player had a total of 9,900 and the second place player had 8,300. The first place player bet 7,000, which is 300 higher than the shutout bet. This player answered incorrectly and was eliminated from the TOC. In game 1 of season 5, the first place player had a total of 8,200 and bet 6,300 approximating the shutout bet. Again the player answered incorrectly and did not progress to the semi-finals of the tournament. Had these players focused on their survival point and bet 0 they would have had a significantly higher chance of entering the semi-finals. We also see this betting pattern in the amounts wagered by first place players answering correctly. For example, in game 1 of season 7, the first place player had 11,200 and bet 5,800. If this player had answered incorrectly his final score would have been 5,800, which was too low to progress to the semi-finals.

Discussion

Some ideas can be raised to explain why the behavior of the contestants appears to be at odds with the notion of strategic best response. For example, a second place player who did not bet All and answered incorrectly is left with say a few hundred dollars. Such an ending may help a player “save face” as it may be embarrassing to end the game with zero dollars in front of the millions of viewers who watch the game. For example, in season 8 game 5 the second place player had a score of 5,700, the player bet 5,100, was wrong and was left with useless 600 points. Another explanation is that contestants may get positive utility from winning the game and thus even though they can secure a place in the semi-finals while betting zero, they still bet a positive amount so as to win the game. A third potential explanation is that some first place players are willing to pay a substantial premium to reach a score of 9,500 that assures a player of qualifying for a wildcard slot in the semi-finals. Three first place players with scores above 8,000 and below 9,000 bet amounts that would result in a score greater than 10,000 but that would not shutout the second place player. These players were buying 20% on the upside but were risking 33% on the down side. Seven first place players with scores above 9,000 and below 10,000 appear to have bet to reach the 10,000. This pattern is also observed in the bets of the players in second place. Three such players with scores above 8,000 appear to have made bets so as to reach 10,000 and one bet to reach 9,000.

These ideas can explain part of the behavior of the players but they are not likely for such professional players. For example, while winning the game assures a player a place in the semi-finals, the players are aware of the high price it may cost them. Winning the game is not a strategically best response in most games and pursuing it is not rational. If in the regular season players, at least those in the lead, behave in a rational manner (Metrick, 1995) this should definitely apply to the select group of players who compete in the TOC. The market mechanism works well in weeding out poor players for the TOC. Also, the meticulous training program each of the contestants goes through in preparation for the TOC makes them much more familiar with the benefits and costs of pursuing different strategies (TOC Report, 2001).

We believe that a major determinant of the failure of the contestants to choose a strategic best response is due to the availability of the two targets, especially when one's choice between them is made under pressure. Despite the TOC contestants' skills, training and the huge incentives, competing in such situations may hamper a person's ability to make optimal choices. Many studies have shown that under time pressure people do not use all the information they have and often resort to simple strategies in calculating the values of alternative routes of action (see e.g., Payne, Bettman, & Johnson, 1993; Wright, 1974). Under time constraints people usually filter information or omit certain information from consideration (Ordonez and Benson, 1997). Furthermore, in stressful situations people often behave in a non- adaptive manner resulting from a phenomenon that can be described as the "narrowing one's attention span." (cf., Yerkes & Dodson, 1908). This may lead to a fixation on one "solution" (target) while neglecting to consider other alternatives. The TOC contestants ignored alternatives open to them and did not behave in an adaptive manner. For example, 29 first place players did not bet the strategic best response but instead bet to shutout the second lace player. Such a response is the strategic best response in the regular season games but not in the TOC.

Most of the above studies examined individual decision behavior under stress, our study, describing decision making under high pressure added two aspects: Very high incentives and competition. It is usually assumed that incentives lead to rational behavior. In the Jeopardy! Game incentives are huge but they may push contestants to become less adaptive. Competition is also assumed to sharpen the behavior of decision makers but the players often focused on one target while ignoring alternative targets and the choices that were available to their competitors (see also, Tor & Bazerman, 2003; Wilson et. al. 2000).

V. Conclusion

The Jeopardy! television game is a high-stakes natural experiment that allows the study of competitive decision-making under pressure. Nalebuff (1990) asked what advice could economists give to the contestants. This was a normative question and if an answer were provided it supposedly would help the players behave optimally. Yet, Metirck (1995) concluded that the players' choice behavior was sub-optimal but not random. The discrepancy between normative models and descriptive aspects of choice behavior has been a major instigating force for the development of behavioral decision-making. In a lucid treatise, Bell, Raiffa and Tversky (1988) argue that without developing both normative and descriptive models of decision making our ability to provide prescriptions for improving choice behavior is minimal. Normative models of competition that draw on sport metaphors are available (Cabral, 2003) but descriptive models of competition are not abundant. The model we described in this paper attempts to do just that. It provides a framework for understanding the pitfalls of experienced players who are familiar with the normative aspects of the game yet fail to apply them. Future research should look at ways, which will allow such experienced players to overcome their natural tendencies to pursue (sometimes) wrong goals and to focus on their own targets while ignoring other alternatives open to them and to their competitors. The strategic best responses in this game are not that complicated and were known to the players, however employing them in a situation of high pressure proved to not to be simple.

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Table 1—Frequency of the States for All Three Players

State* (First, Second, Third)	Number of Observations	Frequency	First Place Player Wins # (%)	Second Place Player Wins # (%)	Third Place Player Wins # (%)
(1, 1, 1)	13	.271	11 (85.0)	2 (15.0)	0
(1, 1, 0)	5	.104	5 (100.0)	0	0
(1, 0, 1)	4	.083	4 (100.0)	0	0
(1, 0, 0)	8	.167	8 (100.0)	0	0
(0, 1, 1)	3	.063	0	2 (66.7)	1 (33.3)
(0, 1, 0)	3	.063	1 (33.3)	2 (66.7)	0
(0, 0, 1)	3	.063	1 (33.3)	0	2 (66.6)
(0, 0, 0)	9	.186	5 (55.6)	4 (44.4)	0
Total	48	1.000	35 (72.9)	10 (20.8)	3 (6.3)

* 1- Correct; 0- Incorrect

Table 2—FJ Bets Made by the First Place Players

Bet	Number of Observations	Frequency
Shutout bet*	21	.438
Bet > Shutout bet	9	.187
Bet < Shutout bet	16	.333
Zero	2	.042
Total	48	1.000

*Shutout bet = 2 * (Second place player score) – (Own score) +1. The scores in the formula are the players scores just before Final Jeopardy bet. It is assumed that both players will answer correctly.

Table 3—FJ Bets Made by the Second Place Players

Bet	Number of Observations	Frequency
Zero	2	.04
All	11	.22
All - 200	4	.08
High	14	.28
Low*	19	.38
Total	50	1.000

*Low bets ensure that the score of the second place player is higher than the score of the first place player minus the shutout bet, if the first place player is wrong.

Table 4—Strategic Best Response Summary*

	Score < 8,000				**Score ≥ 8,000**			
Player Position	Zero	All	Low	High	Zero	All	Low	High
1	1	0	4 (.04)	13 (.08)	1 (.02)	0	14 (.30)	15 (.31)
2	0	14 (.28)	4 (.08)	11 (.22)	0	1 (.02)	9 (.18)	0

*Strategic best response is in the shaded regions.
Frequencies are in parentheses.

Table 5—FJ Bet OLS Regression Results

Variable	First Place Players	Second Place Players
Distance from Aspiration Point (DAP)	-.0146*** (.002)	.0075** (.003)
Distance from Survival Point (DSP)	.002582 (.003)	.0104** (.005)
Correct	14.463** (6.103)	9.108 (8.374)
Bet Maximum		22.753** (11.259)
Focus	2606.88*** (.000)	-20.849* (11.252)
Constant	22.844*** (6.228)	55.502*** (15.693)
Model *F*	15.772***	6.991***
R^2	.60	.44
N	48	50
* p<.10 ** p<.05 *** p<.01 Standard errors are reported in the parentheses		

Figure 1—Amount Needed to Qualify as a Wildcard

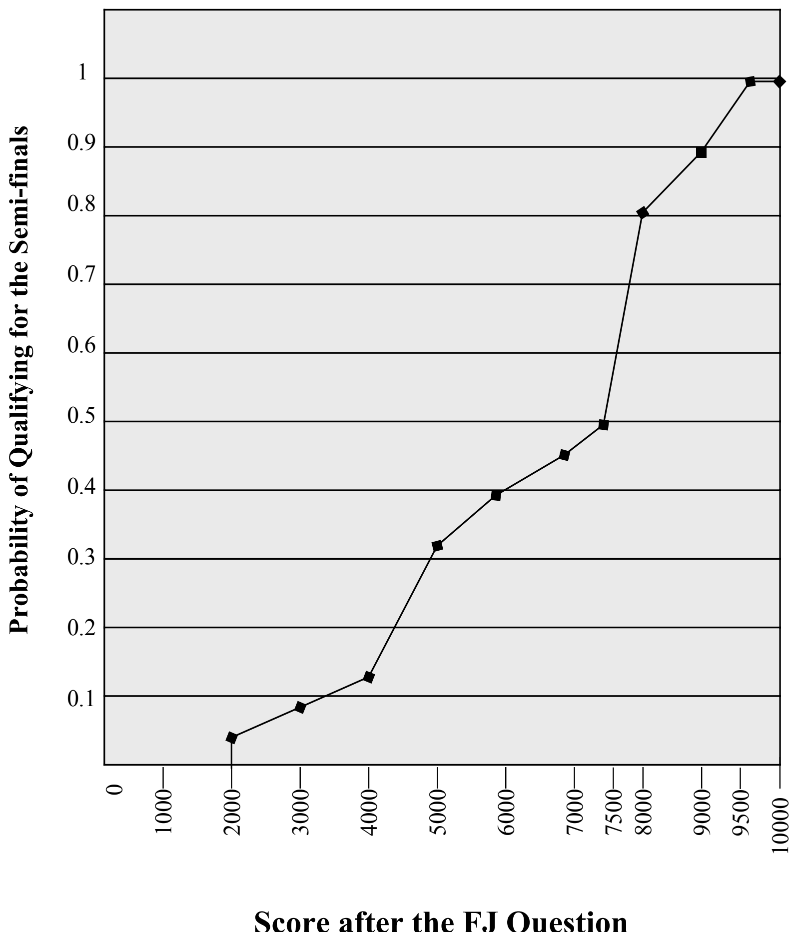
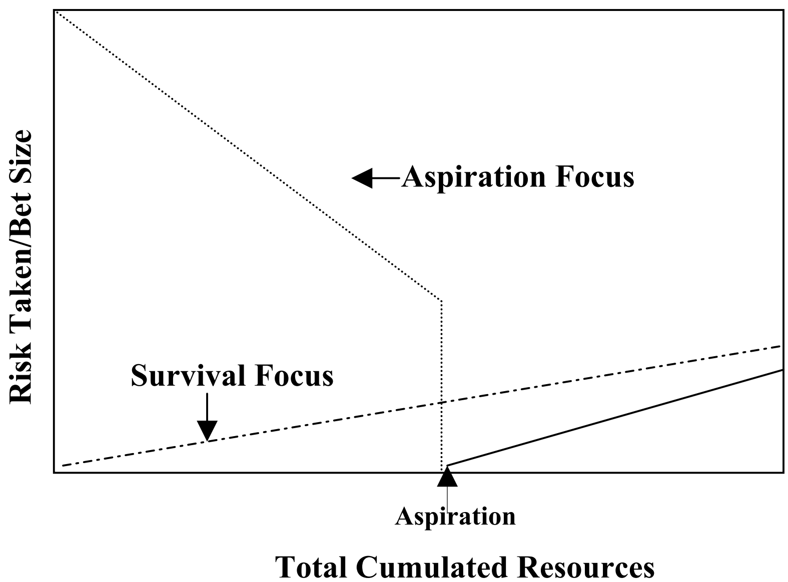


Figure 2—The Variable Risk Preferences Model



APPENDIX
Jeopardy! Game and Tournament of Champions Rules

Rules of the Jeopardy game. Three players play the Jeopardy game. The game is divided into three rounds named: Jeopardy, Double Jeopardy, and FJ (Trebeck & Barsocchini, 1990). Each of the first two rounds contains 30 questions. The 30 questions are divided into six categories with five questions in each. Within a category, the dollar value for each question ranges from 100 to 500 in the Jeopardy round and from 200 to 1,000 in the Double Jeopardy round.

After the host, Alex Trebeck reads each question the player who "rings in" first gets to answer the question (e.g. each player is equipped with a buzzer). If the player answers correctly, that player picks the category and dollar amount of the next question. If the player answers incorrectly, the question can then be answered by one of the two remaining players. Again, the player who "rings in" first is given the opportunity to answer the question. Correct answers increase and incorrect answers decrease the player's score by the dollar value of the question.

During the Jeopardy and Double Jeopardy rounds of play, players encounter Daily Doubles. When a Daily Double opportunity arises, players determine how much they wager on the success of their answer. The player can bet up to the total amount of money they have accumulated to that point in the game. If a player's score is below 500 in the Jeopardy round or 1000 in the Double Jeopardy round they are permitted to bet up to 500 and 1000 respectively. Daily Doubles are questions that can only be answered by the player selecting the question.

All players with a positive score at the end of the Double Jeopardy round play the final round of the game, FJ. In FJ the players are shown a single category from which they are asked one question. All players answer the same question and write down their answers simultaneously. The players know only the category, not the question before they decide how much to bet. Players cannot bet more than their score or less than zero. During a regular game, not a TOC game, the player with the highest score after FJ gets to keep the money they have won and return to play another game with two new competitors. The other two players do not get to keep the money; they get a consolation prize. In the next section we describe the special features of the annual Tournament of Champions.

Rules for the Tournament of Champions. The 10 years of data used in our analyses were taken from the Jeopardy program's annual *Tournament of Champions* (TOC) held between 1991 and 2000. Fifteen contestants are selected to participate in the TOC based on their performance earlier in the given year. These players have either won 5 consecutive games during the prior year or have had the highest dollar winnings among those winning 4 games in a row. Also included in the TOC are the winners of two special tournaments held during the year, the Teenage and College Championships.[3]

The TOC consists of ten games spread over a two-week period. Each of the fifteen contestants plays in one of the first five games. The winners of each game and the four players with highest score among the non-winners become semi-finalists. We refer to the 4 players that progress to the semi-finals based on being among the top 4 money winners as Wildcards. Each of the nine semi-finalists plays in one of three games and the winner of each game becomes a finalist. The three finalists play two games on two consecutive days and the player earning the highest total amount of money in the two games combined becomes the champion. The champion wins 100,000. The remaining 2 finalists receive the money they won in the two games but are guaranteed a minimum of 15,000 for second place and 10,000 for third place. Semi-finalists who do not become finalists receive 5,000 for participating in the show.

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[3]The 2001 TOC did not include the Teen tournament champion.