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ABSTRACT

Anchoring in Financial Decision-Making: Evidence from the Field

This paper analyzes 12,596 wagering decisions of 6,064 contestants in the US game show *Jeopardy!*, focusing on the anchoring phenomenon in financial decision-making. We find that contestants anchor heavily on the initial dollar value of a clue in their wagering decision, even though there exists no rational reason to do so. More than half of all wagers occur within $500 of the initial dollar value, although the maximum possible wagering value averages $5,914. This anchoring phenomenon remains statistically significant on the one percent level, even after controlling for scores, clue category, time trends, and player-fixed effects. When exploiting within-player variation only and implicitly controlling for a host of individual behavioral attitudes and preferences, raising the anchoring amount by 10 percent translates to an increase of 3.1 percent in the wager. In terms of magnitude, anchoring is marginally more pronounced for women with an elasticity of 0.34 versus 0.28 for males. Finally, this paper is among the first to investigate anchoring among children and teenagers. We find little evidence for anchoring among children under the age of 13, but the effect begins to emerge for teenagers and further manifests itself among college students. Overall, our findings suggest anchoring plays a substantial role in financial decision-making under pressure.

JEL Classification: D03, D81, D83, G11

Keywords: anchoring, behavioral economics, financial decision-making, gender differences, heuristics

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1 Introduction

Numerous studies suggest that as individuals make decisions they tend to rely heavily on pieces of information they receive immediately beforehand (see Furnham and Boo, 2011, for a recent overview of the literature). Even arguably unrelated information can influence subsequent decisions. Commonly referred to as "anchoring," Tversky and Kahneman (1974) introduced the concept into behavioral studies. For example, after asking subjects to write down the final two digits of their social security number, those with higher numbers systematically report a greater willingness to pay for items such as a bottle of wine (see Ariely et al., 2003, or Beggs and Graddy, 2009, and List, 2011, for other examples). Quantitative anchoring seems to matter for investment decisions, negotiating processes, reference pricing on consumers, or online auctions (e.g., see Furnham and Boo, 2011, Galinsky and Mussweiler, 2001).

Unfortunately, the anchoring phenomenon has rarely been tested in the field (see Furnham and Boo, 2011), and the majority of what we know about anchoring comes from laboratory studies. Naturally, experimental settings are valuable to analyze particular phenomena in a controlled, well-designed environment, but concerns about external validity are difficult to resolve (Levitt and List, 2007; List and Millimet, 2008). For example, the stakes necessary to reveal true behavior can be high: Antonovics et al. (2009) find results obtained from laboratory settings are comparable with those from the field only when the offered stakes are above US$50 per person. However, this threshold becomes difficult to cross if one wants a large and representative sample. In general, Levitt and List (2008) note that "[p]erhaps the greatest challenge facing behavioural economics is demonstrating its applicability in the real world."

The following pages analyze the anchoring phenomenon among 6,064 contestants in one of the most popular game shows of all time: The US edition of *Jeopardy!*.[1] The

[1] A number of studies have used data from game shows to study economic phenomena, e.g., Gertner (1993), Metrick (1995), Levitt (2004), Antonovics et al. (2005), Post et al. (2008), or Jetter and Walker (2016). However, to our knowledge, no study has used game show data to systematically investigate anchoring.

show provides an environment that is comparable to real-world situations, as high-stakes decisions (the average winner of an episode takes home US$19,752) have to be made quickly. This rich sample focuses on 12,596 wagering decisions in *Daily Double* (*DD* from hereon) clues over 32 years. In every episode, three *DD* clues are hidden among the 60 clues of the *Jeopardy!* and *Double Jeopardy!* rounds, prompting a high-stakes decision by the contestant who happens to (unknowingly) select a *DD* clue. Our study exploits the fact that before contestants learn they have selected a *DD* clue they must select a clue that carries a certain dollar value (e.g., "I take *Fonts* for $1,600!"). After learning the particular clue is a *DD* clue, the contestant can wager up to their entire account balance on responding correctly to the clue.[2] This is precisely where anchoring may occur. The contestant is prepared to play for a clue of, say, $1,600, but now they have to decide within moments how much of their current account balance they are willing to wager on their answering the clue correctly. According to the rules of the game, there should be no rational connection between the initial dollar value of the clue and the wager or the difficulty of the clue. We posit that these dollar values serve as internally generated anchors (also see Epley, 2004).

Indeed, all our estimations suggest a positive and economically meaningful link between the initial dollar value and the wagering amount. In terms of magnitude, an increase in the initial dollar value of the clue by 10 percent translates to a 3.1 percent increase of the wagering amount. This result is persistent to the inclusion of a comprehensive list of potentially confounding factors: Scores (individual and relative to the best opponent), the 20 most common clue categories, time trends (linear and squared), and player-fixed effects. The inclusion of fixed effects allows us to exploit within-player variation only, holding constant all unobservable characteristics that are specific to an individual, such as education, income, personality, cognitive ability, risk preferences, and *Jeopardy!*-specific knowledge.

We then explore potential gender differences in anchoring, as such heterogeneity has

[2] At the time of wagering only the clue category is known, but the clue itself will only be revealed after the contestant wagers.

been discovered in a number of closely related behavioral aspects (Croson and Gneezy, 2009; Niederle, 2014). Although the effect remains strong for either gender, women rely more strongly on the initial dollar value of the clue when making their wagering decision. In terms of magnitude, the elasticity for women is 21 percent higher than for men (coefficient of 0.34 versus 0.28). We also uncover interaction effects with other covariates that particularly address the experience and expertise of the contestant when making their wagering decision.[3] Notably, a higher score in the game diminishes anchoring for either gender, and a larger lead over the strongest opponent amplifies anchoring for women, but not for men. In addition, having answered clues in the same category of clues before (something we can identify as experience) reinforces anchoring, but approximately twice as much for women than for men.

Finally, we analyze anchoring behavior by young *Jeopardy!* participants under the age of 13, teenagers (aged 13 – 17), and college students. Interestingly, the effect does not emerge for children, but then gradually becomes stronger in terms of magnitude and statistical relevance for older age categories. This finding is consistent with other studies in the psychology literature, indicating that individuals may become more prone to heuristics in decision-making as they reach young adulthood (see Table 3 in Reyna and Farley, 2006, or Morsanyi and Handley, 2008). To our knowledge, this paper is among the first to analyze the anchoring phenomenon for children in a real-life setting.

Overall, these findings may help inform the discussion in certain real-life settings where quantitative anchoring may occur – in this case using a numerical anchor to make a wagering decision. For instance, investment decisions by individuals (e.g., stock market speculations), but also by CEOs and major decision-makers in corporations, many times have to be made quickly and under pressure. It is likely that seemingly irrelevant information provided immediately beforehand serves as an anchor and strongly influences decisions. Further, gambling decisions, negotiation processes, or online auctions may be

[3]Various previous works have found that experience and expertise may alleviate anchoring, yet are unlikely to completely suppress the effect. See Furnham and Boo (2011) for a detailed review and respective references.

influenced by anchors. Our results show that magnitudes may be economically sizeable, with an elasticity between the anchor amount and the wager of approximately 0.31.

The paper proceeds with a brief background of the anchoring literature, followed by a description of our data, the *Jeopardy!* setting, and our methodology. Section 4 presents our empirical findings and section 5 concludes.

2 A Brief Background of Anchoring

Researchers broadly distinguish between three potential mechanisms for why people may use seemingly unrelated pieces of information (that are made salient immediately prior) to make decisions: First, and most generally, Tversky and Kahneman (1974) and Epley and Gilovich (2001, 2005) suggest anchoring results from an insufficient adjustment process by the brain from the initially presented value. Second, the "attitude change" explanation states that "[a]nchors could serve directly as a cue or indirectly influence the information processing that bias judgments toward the anchors" (see Furnham and Boo, 2011, p. 37). Third and final, the "selective accessibility" approach suggests individuals may purely test whether a provided anchor is indeed the correct answer. This approach is more applicable when answers can be correct or incorrect, which naturally does not apply in our setting, where contestants need to decide on *how much* to wager on them responding correctly to a clue.

We want to briefly present a couple of examples to illustrate the phenomenon. In one of the few field studies, Johnson et al. (2009) analyze betting on horse races, finding that a horse's barrier position in a previous race serves as a meaningful anchor when calculating odds. They find those with greater levels of expertise to be less subject to anchoring, yet the significance of the effect prevails. Similarly, McAlvanah and Moul (2013) find bookmakers fail to re-adjust fully when a horse is abruptly withdrawn (a late "scratch" in racing terminology) from a race in which betting has already commenced. In this setting, the initial odds emerge as a powerful anchor among economic agents with financial incentives and extensive experience. This effect becomes more pronounced in situations with greater time pressure.

Additional evidence comes from analyzing decisions in financial markets. Kaustia et al. (2008) find students and investment professionals anchor future expectations of stock returns to prior performance. This effect becomes smaller with experience and expertise, but does not disappear. Contrary to this, we find that having experience with the respective clue category *enforces* anchoring behavior. Section 4.5 will provide a more detailed discussion. Further, Liao et al. (2013) find foreign investor trading behavior to be robustly related to previous investing behavior. Closely related, Bucchianeri and Minson (2013) find evidence for anchoring in the US real estate market.

In addition to betting behavior in horse racing and investment decisions, the literature has produced evidence for anchoring in credit card repayment (Stewart, 2009; Agarwal et al., 2013; Jones et al., 2015; McHugh and Ranyard, 2016) and contribution rates to retirement accounts (e.g., Choi et al., 2012). Further, "nudges" have been discussed in this context (e.g., Thaler and Sunstein, 2009), as well as defaults (e.g., Johnson and Goldstein, 2003, considering organ donation by country). Both concepts relate to the idea that a given value or setting is taken as given and highly influences a person's decision. One interpretation of our *Jeopardy!* setting suggests contestants see the initial dollar value as the "default" wager, even though the rules of the game provide no rational reason to think so. In fact, the host Alex Trebek states that *DD* clues require something extra, but the degree of difficulty does not depend on the initial dollar value (Trebeck and Barsocchini, 1990). (In fact, if that were the case we should expect a *negative* correlation: Seemingly easier clues should encourage larger bets, ceteris paribus.)

Another important component of our study relates to pressure: Contestants have to wager on their responding correctly to a clue that is not known at the time (only the category is known) and they have to do so quickly in front of a large television audience. In this context, Baltussen et al. (2016) find individuals take less risk in tasks featuring an uncertain range of outcomes when decisions are made in more public situations. Meub and Proeger (2015) propose that as the cognitive load increases people tend to anchor more. With the fast pace of the game, and the format of being a general knowledge quiz show, anchoring may indeed become particularly salient in *Jeopardy!*. Further, Smith and Windschitl (2011) highlight that arbitrary anchors influence numeric estimates especially when time is limited – just as in our setting, where candidates have to decide within seconds how much to wager.

Overall, the *Jeopardy!* setting analyzed in the following pages incorporates a number of features that are consistent with the main experimental and theoretical studies in this literature. Contestants *i*) are faced with an anchor that should not be rationally related to their wagering decision, *ii*) have to make a quantitative financial decision that involves risk, *iii*) compete for substantial financial stakes, and *iv*) have to make their decision under substantial time pressure in a public forum.

The particular appeal of our setting relates to the large available sample that allows us to control for a rich list of potentially confounding factors, as well as individual fixed effects. Thus, we are able to eliminate the influence of unobservable individual behavioral traits, such as risk preferences, but also individual endowments of income, education, and *Jeopardy!*-specific skills. The stakes are high – an aspect that makes contestants more likely to reveal their true attitudes and behavior (Antonovics et al., 2009). Further, our main sample of adults allows us to test for potential gender differences. Finally, *Jeopardy!* not only features episodes with adult contestants, but also shows with kids, teenagers, and college students. Thus, we are able to test for anchoring across different age groups in the same setting with large stakes – a novel contribution to our knowledge.

3 Data and Methodology

3.1 *Jeopardy!*

3.1.1 Brief Overview of the Show

In September 1984, the game show *Jeopardy!* began its run on US television. The show remains on air today and is the second-most popular show in syndication averaging 25 million weekly viewers (Jeopardy!, 2015).[4] Each episode features three contestants and three rounds: The *Jeopardy!* round with 30 clues, the *Double Jeopardy!* round with 30 clues, and the *Final Jeopardy!* clue, which features a single clue. The *Double Jeopardy!* round differs from the *Jeopardy!* round in that all clue values are doubled and clues are generally more difficult (Trebeck and Barsocchini, 1990). In both rounds, six categories with five clues each are available. Until November 26, 2001, the *Jeopardy!* round consisted of the clue values $100, $200, $300, $400, and $500, whereas the *Double Jeopardy!* round featured the values $200, $400, $600, $800, and $1,000. Since then, all clue values have been doubled.

An example is depicted in Table 1, displaying a typical board. Contrary to most other game shows, the host (Alex Trebek) announces 'clues' and whoever is first to press the buzzer has to pose the correct question. Throughout the paper, we will use the terminology of 'responding' or 'answering' to clues to facilitate readability.

For any ordinary clue, the first one to respond correctly receives the associated money value and is allowed to select the next clue. However, if a contestant is incorrect in their response they will have the dollar value of the clue subtracted from their account balance and the other contestants have the opportunity to respond. The contestant with the highest score at the end of the episode receives their account balance as prize money and is able to return for the next episode, while the second and third place contestants receive consolation prizes. Overall, the average winner in our sample earns US$19,752.

[4]The most popular television show in syndication remains *Wheel of Fortune*, drawing more than 30 million viewers per week. The show has been airing since 1983 (see Wheel of Fortune, 2016).

Table 1: Show #7326, *Double Jeopardy!* round on June 20, 2016. Sally selected *Fonts* for $1600, which happened to be a *DD* clue, and wagered $1500. She answered the clue correctly, raising her balance from $4800 to $6300. Another *DD* clue was hidden under the category World Piece for $1600.

ISTHMUS BE YOUR LUCKY DAY	FONTS	THE BILLBOARD ALL-TIME HOT 100	12 LETTER WORDS	WORLD PIECE	IN THE _____ OF BATTLE
				400	400
			800	800	800
		1200	1200	1200	1200
1600	1600	1600	1600	1600	1600
2000	2000	2000	2000	2000	2000

3.1.2 *Daily Double* Clues

Our analysis focuses on a particular type of clue that appears three times in every episode (once in the *Jeopardy!* round and twice in *Double Jeopardy!*): *Daily Double (DD)* clues. These clues are hidden on the board and whoever happens to select a *DD* clue is able to wager up to their entire account balance on them responding correctly to the ensuing clue (see Trebeck and Barsocchini, 1990).[5] (More precisely, the *Jeopardy!* rules state that a player can wager up to their entire account balance or the largest dollar value on the current board, whichever value of the two is larger.) In the example displayed in Table 1 from an actual show, Sally selected *Fonts* for $1,600, which was a *DD* clue and eventually wagered $1,500. Note that the initial value of the question is made salient instantaneously before the wagering decision, as the contestant has to verbally state the initial dollar value of the clue ("I take *Fonts* for $1,600!"). Quite intuitively, the idea that the anchor is more powerful if made salient right before the respective decision has been highlighted by a number of studies, such as Critcher and Gilovich (2008).

[5]Note that *DD* clues, contrary to regular clues, are only open to the contestant who happened to select the clue, not their opposition.

In theory, the initial dollar amount of the clue should be unrelated to the actual wager. In particular, the difficulty of the *DD* clue is not related to the initial dollar amount under which the clue is hidden. In fact, if a *DD* clue hidden under, say, $1,600 was more difficult than a *DD* clue hidden under $400, a rational response would be to wager *more* on clues with a smaller initial value, not less.[6] Thus, if anything, ascribing difficulty of the clue to the initial dollar value would introduce a negative bias for a potential relationship between the initial dollar value and the wagered amount.

3.1.3 Our Sample

To analyze contestants' behavior in *DD* clues, we access the *J! Archive*, a fan-created website of *Jeopardy!* episodes. As of June 5, 2015, the website contains full information for 4,270 complete adult episodes, including 6,064 players (39.69% female) and 12,596 *DD* clues. Thus, on average, our sample contains 2.08 *DD* clues per player. In an extension to our main findings, we also analyze information from 62 kids episodes (124 contestants aged 13 and under), 202 teenager episodes (254 contestants aged 13 – 17), and 188 episodes with college students (249 contestants). Employing a data specialist, we extracted all information of all available episodes.[7]

In terms of available information, the website lists all three contestants' full names, their accumulated prize money in every clue, the category of the clue, the sequence of clues, and the value of each clue. Further, first names allow us to conjecture player gender. Usually, names are commonly attributable to a gender (e.g., Isabel and Susan are female; James and John are male) and if a name could indicate either gender, a Google search for the full name readily produces a picture of the *Jeopardy!* contestant. The same logic applies for abbreviated first names (e.g., A.C.). This strategy allows us to derive a binary

[6] This follows naturally as the expected value (perceived likelihood of answering a clue correctly multiplied by the wagered value) would be higher for easier clues.

[7] Note that the website does not include all *Jeopardy!* episodes. Since January 5, 2004, every episode is included, but the website occasionally misses episodes from earlier seasons. After checking the episode numbers and available data, we do not find evidence of systematic omissions from the archive. Our key insights are consistent when analyzing only data since January 5, 2004, after which all episodes are available.

gender indicator for all 6,064 contestants.

3.2 Methodology

Our empirical strategy follows an ordinary least squares approach, where we first estimate a univariate regression of the initial dollar value predicting the wagered amount in the respective *DD* clue. We then move to a more complete framework, estimating the wager for *DD* clue c by player i with

$$Wager_{c,i} = \alpha_0 + \alpha_1 Value_c + \boldsymbol{X_{c,i}}\alpha_2 + \boldsymbol{Z_i}\alpha_3 + \epsilon_{c,i}. \tag{1}$$

$Value_c$ represents the initial dollar value of the clue and we interpret a positive and statistically significant value of α_1 as evidence for anchoring. $\boldsymbol{X_{c,i}}$ incorporates the following control variables: The current score of player i in the respective episode, the score distance to the best opponent, a binary indicator for STEM categories, dummies for the 20 most common clue categories of the show, and a daily time trend since the beginning of the show in 1984 (linear and squared).[8] The reason for including these control variables are grounded in previous findings related to anchoring decisions. In particular, experience and expertise have been highlighted as potential drivers of anchoring.[9] Finally, $\boldsymbol{Z_i}$ indicates player-fixed effects and $\epsilon_{c,i}$ constitutes the usual error term. Note that standard errors are clustered on the player level in all our regressions.

After estimating equation 1, we move to employing the natural logarithm of both the wager and the initial dollar amount. We pursue this strategy to facilitate the quantitative interpretation of the derived coefficients as elasticities and to control for the potential influence of outliers in wagering.

[8] The 20 most common categories are science, before & after, literature, potpourri, American history, world history, sports, business & industry, world geography, U.S. cities, colleges & universities, animals, transportation, religion, U.S. geography, opera, authors, people, food, and the Bible.

[9] For instance, see several works by Birte Englich with co-authors (Englich et al., 2005; Englich et al., 2006; Englich and Soder, 2009) and Thomas Mussweiler (e.g., Mussweiler et al., 2000).

4 Empirical Findings

We begin our empirical analysis with basic descriptive statistics and the corresponding regression analysis of our main setting. We then discuss robustness checks for different time periods in our 32 year sample, before splitting the data by gender and finally considering anchoring among children, teenagers, and college students in *Jeopardy!*.

4.1 Descriptive Statistics

Figure 1 provides a distribution of the difference between the realized wager and the corresponding initial dollar amount of all 12,596 *DD* clues. The pure correlation coefficient of these two variables reaches a value of 0.44 and Figure 1 confirms that an extraordinary number of wagers fall closely to the initial dollar amount. In fact, more than half of all wagers fall within \$500 of the initial dollar amount and over 76 percent fall within \$1,000, even though the maximum possible wager averages \$5,914.

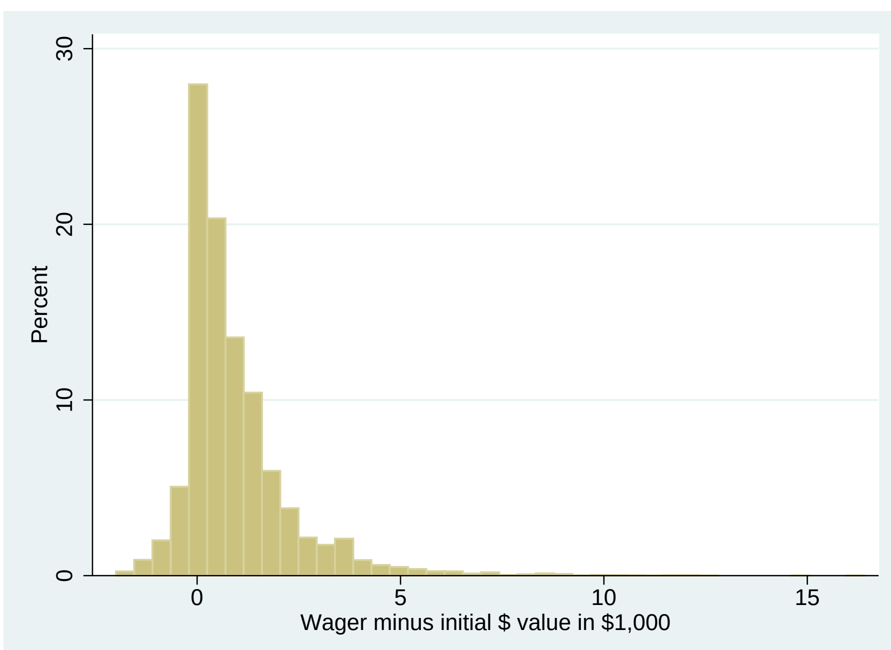

Figure 1: Distribution of actual wager minus initial \$ amount of *Daily Double* clue (in \$1,000).

Table 2 presents summary statistics of the variables employed in the main analysis (the 20 most prominent *Jeopardy!* categories are omitted due to space constraints). Note that we display all dollar values in terms of $1,000 to facilitate the interpretation of coefficients in the upcoming regression analysis. (Otherwise, coefficients display a number of zero digits.) With these descriptive statistics in mind, we now move to our main regression results, investigating whether (and if so, how much) the initial dollar amount of the clue is predictive of the wagered amount.

Table 2: Summary statistics of all 12,596 *DD* clues for the adult sample.

Variable	**Mean**	**(Std. Dev.)**	**Min.**	**Max.**
Wager in $1,000	1.924	(1.519)	0.005	18
Initial $ amount in $1,000	1.026	(0.494)	0.1	2
Score in $1,000	5.914	(5.028)	-4.2	39
Score distance to best opponent	-0.129	(5.190)	-37.1	35.6
STEM clue	0.069	(0.253)	0	1
Clues answered current category	1.527	(0.875)	0	5
# of *DD*'s before	1.278	(2.309)	0	37
Female	0.397	(0.489)	0	1

4.2 Main Results

Table 3 displays our main results, beginning with a univariate regression of the wagering amount on the initial dollar value. Columns (1) through (4) employ actual dollar values, whereas columns (5) and (6) display findings from using the natural logarithm on our two key variables. Throughout all estimations, the initial dollar amount is statistically significant on the one percent level in its predictive power. This result is robust to incorporating the suggested control variables from equation 1, but also when including a gender dummy and time trends. The initial dollar value alone is able to explain more than 19 percent of the variation in wagering decisions, as indicated by the R^2 value in column (1). Note that the magnitude of the effect decreases to 0.199 in column (3), indicating that an increase in the initial dollar amount by $1,000 would be associated with an increase in the wagering amount by $199.

Column (4) provides a tighter econometric framework by incorporating player-fixed effects. This estimation controls for any unobservable individual characteristics that are not captured by our control variables, such as education and income levels, but also *Jeopardy!*-specific knowledge and skills, and risk preferences. Further, player-fixed effects also control for those individual factors that have commonly been suggested to drive anchoring behavior: Cognitive ability, personality, and, more generally, the Big Five personality traits.[10] Note that the econometric precision and consistency with which the anchoring phenomenon prevails is remarkable, especially when considering that the sample only provides little more than 2 *DD* clues per contestant, on average. In terms of magnitude, column (4) predicts a $1,000 dollar increase in the initial dollar amount translates to a $242 increase in the wagering amount.

Columns (5) and (6) replicate columns (3) and (4), but employ the natural logarithm for the key variables: The wagering amount (dependent variable) and the initial dollar amount.[11] We consistently note the initial dollar amount to be a robust and economically sizeable predictor of wagering. In the most complete estimation, an increase in the initial dollar amount by 100 percent relates to an increase in the wagering amount by 31 percent. Thus, contestants tend to use the initial dollar amount as an important anchor for wagering decisions.

Finally, we also wish to briefly discuss the derived coefficients of the main control variables. First, as expected, a higher score allows a contestant to wager more, everything else equal. Somewhat understandably, a larger positive difference to the best opponent

[10] See Furnham and Boo (2011) for an overview of the associated literature. Bergman et al. (2010) find that anchoring is less pronounced for individuals with higher cognitive ability, whereas Frederick (2005) discusses how cognitive ability should impact economic decision-making in general.

[11] Note that we do not employ the natural logarithm for the contestant's score (individual and relative to the best opponent), because these variables can take on negative values. Thus, we would lose those observations when employing the logarithm. Nevertheless, all results are consistent when applying the natural logarithm too all dollar-denominated variables.

Table 3: Main results from OLS regressions, estimating the $ amount wagered in *Daily Double* clue. Columns (5) and (6) predict the natural logarithm of the wagered $ amount.

Dependent variable:	Wager in $1,000				Ln(wager in $1,000)	
	(1)	(2)	(3)	(4)	(5)	(6)
Initial $ amount in $1,000	1.348***	0.384***	0.199***	0.242***		
	(0.028)	(0.041)	(0.045)	(0.059)		
Ln(initial $ amount in $1,000)					0.288***	0.310***
					(0.018)	(0.025)
Score in $1,000		0.165***	0.166***	0.150***	0.061***	0.052***
		(0.006)	(0.006)	(0.007)	(0.002)	(0.003)
Score distance to best opponent		-0.086***	-0.086***	-0.098***	-0.036***	-0.040***
		(0.005)	(0.005)	(0.007)	(0.002)	(0.003)
Clues answered current category		0.007	0.035**	0.033	0.018**	0.009
		(0.015)	(0.015)	(0.020)	(0.008)	(0.010)
# of *DD*'s before		0.026***	0.021**	-0.005	0.004	-0.008
		(0.009)	(0.009)	(0.012)	(0.003)	(0.006)
Fixed effects for 20 most common categories and STEM clues		yes	yes	yes	yes	yes
Female			-0.079***		-0.033**	
			(0.026)		(0.013)	
Trend (linear & squared)			yes	yes	yes	yes
Player-fixed effects				yes		yes
# of players	6,064	6,064	6,064	6,064	6,064	6,064
# of years	32	32	32	32	32	32
N	12,596	12,596	12,596	12,596	12,596	12,596
Adjusted R^2	0.192	0.302	0.314	0.368	0.312	0.369

Notes: Standard errors clustered on the player level are displayed in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

induces smaller wagering amounts, presumably because a contestant does not want to lose their lead in case of an incorrect answer. Second, the significant gender effect in wagering behavior (columns 3 and 5) is consistent with the majority of the associated literature: On average, women tend to take on less risk in wagering decisions than men.[12] We will return to differences in anchoring behavior by gender shortly (section 4.4). But first, we now evaluate whether anchoring has differed throughout our entire sample of 32 years.

4.3 Robustness Check: Different Time Periods

Building on the results from column (6) of Table 3, Table 4 focuses on whether anchoring in *DD* clues has changed over time. Column (1) amends our most complete estimation by incorporating year-fixed effects. The anchoring effect prevails and remains close to the initial coefficient in terms of magnitude (0.306 versus 0.31).

Further, columns (2) through (6) break our entire sample period of 32 years into four 8-year periods. These estimations reveal a slight drop in terms of magnitude over time, as the corresponding elasticity becomes 0.407 in the years 1984-1991, but then decreases until the early 2000s. Since then, the coefficient of interest has remained stable with 0.235. Thus, anchoring remains important throughout the entire sample period, but magnitudes have decreased by approximately 40 percent since the 1980s. One possible explanation, although speculative at this point, could be related to better preparation of candidates about wagering strategies in recent years.[13]

With these results in mind, we now move to analyzing potential heterogeneity along the lines of gender and age.

[12] For discussion, see Jianakoplos and Bernasek (1998), Byrnes et al. (1999), Eckel and Füllbrunn (2015), or Jetter and Walker (2016).

[13] An example can be found on Ken Jenning's website (`http://www.ken-jennings.com/faq`, by far the most successful *Jeopardy!* contestant in history) or in online forums, such as *quora* (`https://www.quora.com/What-are-the-best-ways-to-prepare-to-be-a-contestant-on-Jeopardy`).

Table 4: Estimating the natural logarithm of the $ amount wagered in *Daily Double* clues, including year-fixed effects and analyzing subperiods.

	(1)	(2)	(3)	(4)	(5)
Years included:		1984-1991	1992-1999	2000-2007	2008-2015
Ln(initial $ amount in $1,000)	0.306***	0.407***	0.306***	0.235***	0.235***
	(0.025)	(0.072)	(0.063)	(0.045)	(0.045)
Control variables[a] & year-fixed effects	yes	yes	yes	yes	yes
Player-fixed effects	yes	yes	yes	yes	yes
Year-fixed effects	yes	yes	yes	yes	yes
# of players	6,064	556	1,274	2,176	2,203
# of years	32	8	8	8	8
N	12,596	1,032	2,513	4,485	4,566
Adjusted R^2	0.371	0.352	0.320	0.352	0.205

Notes: Standard errors clustered on the player level are displayed in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
[a]Includes score in $, score distance to best opponent, STEM and 20 most common categories, clues answered in current category before, the number of *DD*'s before, and time trend (linear and squared).

4.4 Distinctions by Gender and Age

Following a series of papers that have identified gender differences in a variety of related behavioral traits, we now evaluate whether such a tendency can also be observed in anchoring.[14] Considering pure descriptive statistics reveals a small, but noticeable, gender difference in the wagering behavior. The average woman in our sample wagers $870 more than the initial dollar amount, whereas the average man wagers $915 more. The difference between these two means is statistically significant on the ten percent level.

To check whether such differences prevail in our regression analysis with control variables and fixed effects, the first two columns of Table 5 display coefficients from splitting our main sample into a female and a male subsample. Indeed, we find women to be more inclined to anchor on the initial dollar value, as the respective coefficient increases to 0.339, whereas the corresponding effect for men settles on 0.281. However, the two coefficients are not statistically different from each other on conventional levels, as a z-test produces a value of 1.132. Thus, we cannot say with certainty that there are systematic gender differences in anchoring behavior.

Beyond gender, it has often been argued that behavioral traits are only acquired with time and not necessarily persistent among children and adolescents. As an example, Andersen et al. (2013) find that young girls are as competitive as boys, and only in patriarchal societies do we observe significant gender differences after puberty. To check whether anchoring emerges for younger *Jeopardy!* participants, we now access 62 kids episodes with participants aged under 13, 202 teenager episodes (aged 13 – 17), and 188 episodes with college students. Because of much diminished sample sizes, we neither incorporate control variables for STEM clues and the 20 most common clue categories in these estimations, nor player-fixed effects. (Nevertheless, recall that the difference between the results from a fixed-effects approach and a pooled estimation from columns (5) and (6) in Table 3 are minor, suggesting a pooled estimation is likely to produce

[14] For overviews of the respective gender literature, we refer to Croson and Gneezy (2009) and Niederle (2014).

Table 5: Extensions by gender and age, estimating the natural logarithm of the $ amount wagered in *Daily Double* clues.

	(1)	(2)	(3)	(4)	(5)
Sample:	Females	Males	Kids	Teenagers	College students
Ln(initial $ amount in $1,000)	0.339***	0.281***	0.090	0.156**	0.262***
	(0.040)	(0.032)	(0.208)	(0.075)	(0.069)
Control variables I[a] & year-fixed effects	yes	yes	yes	yes	yes
Player-fixed effects	yes	yes			
Control variables II[b]	yes	yes			
# of players	2,677	3,387	124	254	249
# of years	32	32	12	20	23
N	4,999	7,597	182	606	559
Adjusted R^2	0.342	0.386	0.090	0.398	0.315

Notes: Standard errors clustered on the player level are displayed in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. [a]Includes score in $, score distance to best opponent, clues answered in current category before, the number of *DD*'s before, and time trend (linear and squared). [b]Excludes the binary indicator for female, but includes binary indicators for STEM clues and the 20 most common categories.

consistent results.) The respective summary statistics are referred to the appendix.

Columns (3) through (6) of Table 5 present the corresponding results. Comparing the respective coefficients with our benchmark magnitude (0.310) shows substantially different effects for younger participants. In fact, for kids under the age of 13 we find no statistically meaningful relationship between the initial dollar value and their wagering amount. Thus, children may not anchor when making financial decisions that involve risk, at least not in this particular game show setting. This finding is consistent with other studies from the psychology literature on the age when heuristics in decision-making develop (e.g., see Table 3 in Reyna and Farley, 2006, or Morsanyi and Handley, 2008). The development of the anchoring effect in young adulthood is confirmed when considering teenagers, as the effect is now statistically significant on the five percent level with a magnitude of 0.156. Although still decisively smaller in terms of magnitude than the benchmark effect derived for adults (the difference between both coefficients is statistically significant on the ten percent level), we notice a systematic relationship between the initial dollar amount and the wager, meaning that anchoring behavior now appears to form. For college students, we then derive an effect that is statistically indistinguishable from the effect observed for adults.

Finally, Figure 2 visualizes the coefficient of all main regressions, including a two-sided five percent confidence interval. The first coefficient displays the benchmark results from column (6) in Table 3 and the remaining five coefficients display the results from Table 5. Overall, anchoring appears to occur for adult women and men, as well as for college students. We see some preliminary evidence for teenagers, whereas children under the age of 13 appear to be immune to using the initial dollar value as an anchor in their wagering decisions. Thus, anchoring appears to develop over time, as opposed to being an inherent behavioral trait.

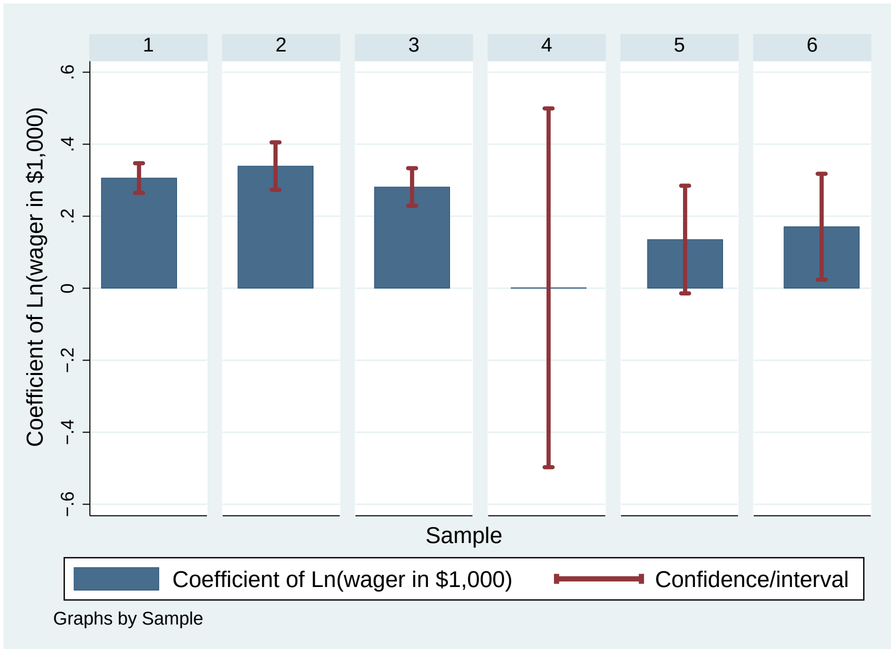

Figure 2: Anchoring coefficient estimates. 1: full sample (coefficient derived in column 6 of Table 3); 2: adult women; 3: adult men; 4: kids; 5: teenagers; 6: college students (coefficients derived from columns 2 through 5 of Table 5).

4.5 Interaction Effects

Finally, we conclude our empirical analysis with an investigation of potential heterogeneity along the lines of our control variables. In particular, expertise and experience have been found to be factors that can alter the anchoring effect (yet they have not been found to completely render it insignificant; see Furnham and Boo, 2011, for a summary). Table 6 displays results from six additional regressions, beginning with the full adult sample and a split by gender, followed by our additional samples of children, teenagers, and college students.

In all estimations, we add interaction terms of our main independent variable (the initial dollar amount) and the following control variables: Score (absolute and relative to best opponent), STEM clues, time trend, the number of clues answered in the same category, and the number of *DD* clues the contestant has faced in their prior *Jeopardy!* career. In particular, we wish to identify whether anchoring becomes more prevalent in some situations of the game show, in addition to testing whether the raw anchoring effect is robust to such extensions. Further, we also incorporate an interaction term with gender in the younger age categories to test for potential gender heterogeneity.

The results for our adult sample in columns (1) through (3) produce three additional insights, beyond the fact that the raw anchoring effect prevails. First, and generally, a larger score leads contestants to rely less on anchoring, whereas a larger lead reverses that trend. Although speculative at this point, it is possible that a larger lead lessens the strategic considerations of wagering, producing a greater reliance on initial dollar values. Most importantly, expertise seems to matter and can likely influence anchoring behavior.

Second, and somewhat surprisingly, having answered more clues in the respective category (e.g., *Fonts*, see Table 1) leads to an even greater reliance on the initial dollar value. This is interesting in the light of previous findings that suggest the magnitude of anchoring would *diminish* with experience. If we interpret the number of clues answered in the same category as an indicator of experience, we find the opposite. However, another interpretation of having answered clues correctly before relates to the idea that the contestant is already in the spotlight and recent studies have shown that people tend to become more risk-averse once the eyes are on them (see Baltussen et al., 2016). This may apply to anchoring as well: As the brain is more occupied, we may also rely on anchors more heavily (Furnham and Boo, 2011; Meub and Proeger, 2015; see Kahneman, 2011, for a broader context). In other words, the cognitive load and excitement of answering multiple clues correctly in a row may cause an overreliance on the initial dollar value. However, these potential explanations can only remain speculative at this point.

Third, columns (2) and (3) reveal interesting gender differences in these effects. In particular, only women's anchoring behavior is affected by distance to the best competitor, whereas males' is not. Similarly, women's anchoring behavior is affected twice as much than men's by the number of clues answered previously in the same category (coefficient of 0.094, compared to 0.046). Nevertheless, the difference between both coefficients is not statistically significant on conventional levels, implying caution in over-emphasizing

Table 6: Extensions by gender and age, estimating the natural logarithm of the $ amount wagered in *Daily Double* clue.

	(1) Full sample	(2) Females	(3) Males	(4) Kids	(5) Teenagers	(6) College students
Ln(initial $ amount in $1,000)	0.459***	0.667***	0.346**	0.301	0.808**	-0.030
	(0.119)	(0.217)	(0.142)	(1.884)	(0.382)	(0.486)
Ln(initial $ amount in $1,000) × Score in $1,000	-0.062***	-0.063***	-0.063***	-0.101*	-0.061***	-0.064***
	(0.005)	(0.008)	(0.006)	(0.052)	(0.013)	(0.022)
Ln(initial $ amount in $1,000) × Score distance to best opponent	0.012**	0.025***	0.007	0.013	0.019	0.003
	(0.005)	(0.009)	(0.006)	(0.045)	(0.015)	(0.019)
Ln(initial $ amount in $1,000) × STEM clue	-0.022	-0.111	0.033			
	(0.060)	(0.108)	(0.072)			
Ln(initial $ amount in $1,000) × time trend (by day)	-0.000	-0.000	0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(initial $ amount in $1,000) × clues answered current category	0.064***	0.094***	0.046**	0.108	0.026	0.021
	(0.017)	(0.027)	(0.023)	(0.171)	(0.055)	(0.072)
Ln(initial $ amount in $1,000) × # of DD's before	-0.006	-0.012	-0.008	-0.274*	0.039	-0.035
	(0.006)	(0.020)	(0.006)	(0.160)	(0.036)	(0.036)
Female				-2.112	-0.721	-0.928
				(2.345)	(0.613)	(0.715)
Ln(initial $ amount in $1,000) × female				0.321	0.085	0.136
				(0.336)	(0.092)	(0.110)
Control variables I[a] & year-fixed effects	yes	yes	yes	yes	yes	yes
Control variables II[b]	yes	yes	yes			
Player-fixed effects	yes	yes	yes			
# of players	6,064	2,677	3,387	124	254	249
# of years	32	32	32	12	20	23
N	12,596	4,999	7,597	182	606	559
Adjusted R^2	0.396	0.375	0.412	0.177	0.462	0.369

Notes: Standard errors clustered on the player level are displayed in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. [a]Includes score in $, score distance to best opponent, clues answered in current category before, the number of *DD*'s before, and time trend (linear and squared). [b]Includes binary indicators for STEM clues and the 20 most common categories.

these results. Overall, columns (2) and (3) reinforce the idea that anchoring can be more pronounced for women than for men, although the effect emerges with force for either gender. Such heterogeneity may provide an interesting avenue for future research, suggesting that women and men may anchor differently.

Finally, columns (4) through (6) consider the same heterogeneity of anchoring for our additional samples. Most importantly, we continue to see a zero effect for children and this effect does not seem to be masked by potential interaction effects. For teenagers and college students, we observe results that are mostly consistent with those from the adult sample in column (1). In this context, it is useful to remind ourselves of the diminished sample sizes, which translates to inflated standard errors and makes it difficult to isolate consistent patterns.

5 Conclusion

This paper studies anchoring in a real-life quantitative setting, focusing on the wagering decisions of 6,064 contestants in the US game show *Jeopardy!*. Our study aims to complement the experimental literature on the anchoring phenomenon, in particular by investigating a real-life setting that provides a large sample and meaningful payoff scenarios. Naturally, both of these dimensions (large N, sizeable payoffs) are difficult to expand in laboratory experiments. Further, we test for potential heterogeneity along the lines of gender and age when it comes to anchoring behavior.

Our results produce robust evidence for the hypothesis that people anchor their wagering decision on seemingly unrelated dollar values that have been made salient immediately preceding the wagering decision. The initial dollar amount emerges as a statistically powerful predictor of the wagering amount, and this result remains robust to the inclusion of a comprehensive list of potentially confounding factors, time trends, time-fixed effects, and especially player-fixed effects. Our large sample allows us to rely on within-player variation only, therefore eliminating noise from individual characteristics that are unobservable, such as income and education, *Jeopardy!*-specific skills, and risk preferences. In terms of magnitude, doubling the anchor value translates to an increase of approximately 31 percent in the wagered amount.

Interestingly, children aged 13 and younger do not show a significant correlation between the initial dollar amount and their wagering decision. The effect emerges for teenagers, but still exhibits a smaller magnitude with a coefficient of 0.156, approximately one half of the benchmark effect for adults. In turn, college students display an anchoring effect that is virtually identical to that of adults. Thus, anchoring appears to become relevant as people reach adulthood, but may not be a meaningful behavioral trait for children. Finally, we find women to marginally anchor more in terms of magnitude than men, as the corresponding elasticity reaches a value of 0.339 (men: 0.281).

Overall, our results enforce the notion that people use numerical anchors when making financial decisions. As such, our results may fit closest into the anchoring mechanism commonly described as "attitude change:" Anchors could directly serve as a cue or indirectly influence information processing that biases judgments toward the anchors (see Furnham and Boo, 2011). It is also interesting that we do not observe this effect for children under the age of 13, further highlighting the idea that behavioral traits may only be learned in life, as opposed to being inherent. Similarly, the fact that women seem to anchor more than men can provide meaningful insights into financial decision-making.

In practice, potential fields of application can be found in gambling decisions, negotiation processes, reference pricing for consumers, online auctions, and (potentially most importantly) investment decisions. Anchoring may also carry implications for risk-taking of CEOs and managerial personnel in large financial institutions.

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Appendix

Table AI: Summary statistics for kids sample (182 observations).

Variable	Mean	(Std. Dev.)	Min.	Max.
Wager in $1,000	1.777	(1.584)	0.01	11
Initial $ amount in $1,000	1.202	(0.475)	0.2	2
Score in $1,000	7.252	(5.790)	-1.6	24.8
Score distance to best opponent	0.187	(5.718)	-22.2	18.4
STEM clue	0.099	(0.299)	0	1
Female	0.500	(0.501)	0	1
Clues answered current category	1.560	(0.857)	0	4
# of DD's before	0.434	(0.625)	0	2

Table AII: Summary statistics for teenager sample (606 observations).

Variable	Mean	(Std. Dev.)	Min.	Max.
Wager in $1,000	1.944	(1.677)	0.078	18
Initial $ amount in $1,000	1.034	(0.510)	0.2	2
Score in $1,000	6.230	(5.175)	-1.6	38.4
Score distance to best opponent	-0.335	(4.955)	-19.4	23.8
STEM clue	0.111	(0.314)	0	1
Female	0.401	(0.491)	0	1
Clues answered current category	1.457	(0.863)	0	4
# of DD's before	1.147	(1.379)	0	7

Table AIII: Summary statistics for sample of college students (559 observations).

Variable	Mean	(Std. Dev.)	Min.	Max.
Wager in $1,000	1.771	(1.284)	0.005	9.800
Initial $ amount in $1,000	1.008	(0.487)	0.2	2
Score in $1,000	5.780	(4.708)	-0.3	28.2
Score distance to best opponent	-0.297	(4.414)	-19	20.8
STEM clue	0.091	(0.288)	0	1
Female	0.381	(0.486)	0	1
Clues answered current category	1.467	(0.822)	0	4
# of DD's before	1.084	(1.288)	0	6