Gender differences in competitiveness and risk-taking among children, teenagers, and college students: Evidence from *Jeopardy!*[*]

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Abstract

Studying *Jeopardy!* in the US, we explore whether and when gender differences in competitiveness and risk-taking emerge with age and by opponents' gender. We identify no gender differences in (i) winning episodes, (ii) responding or (iii) responding correctly to clues. Males begin to wager substantially more as they become teenagers (but not children), leading to the emergence of the gender gap, equivalent to a 7.3 percentage point gap or approximately $451. This gap persists for college students. Finally, male teenagers and college students wager substantially *less* when competing against females, whereas the gender of opponents does not influence females' behaviour.

JEL Classifications: D81; D90; D91; G41; J16

Keywords: gender and competition; gender and risk; mixed-sex; performance under high pressure; gender of opponents

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1 Introduction

Gender differences in competitive behavior and risk-taking have been well documented in a range of settings – and the evidence suggests that they matter substantially for real-life outcomes. For example, such gender differences could ultimately explain part of the gender gaps in wages and occupational choices.[1] Unfortunately, it remains difficult to determine at which age and under what circumstances these gender differences emerge. However, understanding the *when* becomes crucial if we want to draw up potential policy recommendations or, more generally, if we want to identify the underlying sources of such heterogeneity. For example, if young girls (say, before puberty) are already more risk-averse than boys, such behavioural traits may indeed operate on a fundamentally different basis for females and males, perhaps favouring biological and genetic explanations. In that case, potential interventions in high school to increase females' levels of risk-taking (or, alternatively, to decrease males') may be fruitless. On the other hand, if such gender differences are non-existent among children, a nurture-based explanation becomes more likely and we may be able to pinpoint when and why exactly we see a gender divergence in competitive behaviour and risk-taking.

Further, surrounding circumstances may be able to affect children's and adolescents' actions. For example, time constraints (Cotton et al., 2013) or the type of task could influence females' and males' competitive behavior differently.[2] In addition, recent studies suggest that the gender of one's opposition could play a role (e.g., see Booth and Nolen, 2012b, Booth et al., 2014, Säve-Söderbergh and Lindquist, 2017, and Jetter and Walker, 2017b). Again, if gender differences in behaviour were indeed circumstantial and one or a combination of these attributes mattered, society may be more able to influence them, if desired.

[1] For instance, see Manning and Swaffield (2008), Croson and Gneezy (2009), and Le et al. (2011) for the gender wage gap. We refer to Kleinjans (2009), Buser et al. (2014), and Flory et al. (2014) for occupational choices.

[2] Shurchkov (2012) suggest that verbal and non-verbal tasks could affect competitive behaviour differently for women and men; Günther et al. (2010) and Iriberri and Rey-Biel (2017) point out that tasks can be 'gender-specific'; Healy and Pate (2011) propose a team setting may be more conducive to women's performance levels than an individual setting.

The following pages aim to contribute to our understanding of three research questions associated with these topics, analysing unique data from *Jeopardy!*, one of the most prominent US game shows in history:

1. At what age (if any) do we observe gender differences in *competitiveness*?

2. At what age (if any) do we observe gender differences in *risk-taking*?

3. Does the gender of opponents influence *competitiveness* and/or *risk-taking*?

The game show *Jeopardy!*, which will be explained in more detail in Section 2, presents a real-life setting where (i) stakes and pressure are high, (ii) participants of different age groups make decisions in an identical setting, and, relevant to our third research question, (iii) contestants cannot decide the gender of their opponents (also see Lindquist and Säve-Söderbergh, 2011, Säve-Söderbergh and Lindquist, 2017, Jetter and Walker, 2017a, and Jetter and Walker, 2017b, for these attributes of *Jeopardy!*). Specifically, we access information from 1987-2014 on 186 *Jeopardy!* contestants in kids episodes (aged 10-12), 310 contestants in teen episodes (aged 13-17), and 299 contestants from episodes featuring undergraduate college students.

Concerning research question number 1, the existing literature has produced somewhat conflicting findings. Some studies suggest young females to be less effective in competitive settings than males (e.g., see Gneezy and Rustichini, 2004, and Sutter and Glätzle-Rützler, 2015, for children; Gneezy et al., 2003, study college students; Säve-Söderbergh and Lindquist, 2017, study *Junior Jeopardy!* contestants in Sweden), whereas others do not identify such differences (e.g., Dreber et al., 2011, Cárdenas et al., 2012, Andersen et al., 2013, Samak, 2013, and Khachatryan et al., 2015).[3] Our results suggest virtually no gender differences in any competition-related outcomes for children, teenagers, or college students. This remains true once we control for an array of potentially confounding factors, such as clue categories and scores (absolute and relative to opponents).

Moving to research question number 2, the hypothesis of gender differences in *risk preferences* emerging at early ages has generally received stronger support than the corresponding

[3] *Panel A* of Table A1 provides a more detailed overview of related studies for the interested reader.

hypothesis concerning competitiveness. Byrnes et al. (1999) provide a meta analysis of 150 such studies and since then a range of laboratory experiments have suggested females to be more risk averse than males across virtually all age groups.[4] In our *Jeopardy!* setting, we find girls and boys aged 10-12 years to be indistinguishable in their risk-taking behaviour – a result that is in line with those from Säve-Söderbergh and Lindquist (2017), who study 221 contestants of *Junior Jeopardy!* in Sweden. However, our analysis provides a unique insight into when and how females may begin to differ from males in their risk-taking attitudes: Specifically, males begin to wager substantially more as they become teenagers, which then gives rise to the gender gap. The corresponding magnitude is economically sizeable with an average of $451, which is equivalent to approximately 23 percent of an average wager or more than one quarter of a standard deviation. This gender gap prevails for college students, albeit at marginally smaller magnitudes ($297, on average).

Finally, and concerning research question number 3, we take advantage of the fact that contestants cannot choose the gender of their opponents in *Jeopardy!* (each episode features three contestants). This distinction is important because in reality people likely self-select into gender environments they prefer, which makes it virtually impossible to isolate the causal effect of the opposition's gender on an individual's performance and risk-taking behaviour in the field. Consequently – and with the exception of Lindquist and Säve-Söderbergh (2011), Säve-Söderbergh and Lindquist (2017), and Jetter and Walker (2017b) – previous studies exploring the potential role of opponents' gender have been conducted in the laboratory, where the researcher can randomise the gender of opponents. The corresponding findings suggest *single*-sex environments to increase females' likelihood to select into competition, perform better, and risk more (e.g., see Gneezy et al., 2003, Booth and Nolen, 2012a,b, Booth et al., 2014, or Booth and Yamamura, 2017). Conversely, De Paola et al. (2015) find that the gender of opponents does not affect the performance of female undergraduate students in Italy. Finally, Jetter and Walker (2017b) suggest women may actually perform *better* and risk *more* in the presence of men, studying adult

[4] We refer to Cárdenas et al. (2012) and Charness and Gneezy (2012) for evidence from Colombia and Sweden, Gong and Yang (2012) for results from matrilineal and patriarchal societies in China, and Khachatryan et al. (2015) for evidence from Armenia. *Panel B* of Table A1 provides an overview of the associated literature.

Jeopardy! contestants. Interestingly, our findings here suggest that young females' performance and risk-taking remains unaffected by the gender of their opposition. This result prevails across all our three age groups. However, the gender of opponents does seem to matter for men as male teenagers and college students wager significantly less when competing against females. We also find some evidence of male teenagers performing worse when competing against females. Intuitively, male contestants near puberty may feel awkward or intimidated when females are present, but may mature out of this as our college sample does not reveal such a pattern.

Overall, our findings suggest that potential gender differences in competitiveness and risk-taking are by no means invariant across ages and settings. Perhaps most importantly, the clear delineation between separate children, teenager, and college episodes allows us to pinpoint when and how gender differences in risk-taking appear to emerge. It is males who begin to wager substantially more as they become teenagers, thereby giving rise to the gender gap in risk-taking. However, before that, girls' and boys' wagering behavior does not differ in a statistical sense. Further, the finding that male teenagers wager more conservatively when competing against females supports the idea that environmental aspects can influence how much risk we take, even at young ages.

The paper proceeds with a description of our data and methodology, followed by a detailed description of our findings in Section 3. Finally, Section 4 concludes.

2 Data and Methodology

2.1 Show Description

Jeopardy! averages 25 million viewers per week (Jeopardy!, 2015) and ranks as the second largest game show in syndication. The show organises episodes in four demographic categories: kids (aged 10-12 years), teenagers (aged 13-17), undergraduate college students (must be a full-time student and not have completed a bachelor's degree), and adults (over the age of 18). This paper will focus on the first three categories, as we are interested in competitiveness and risk-taking at young ages. Jetter and Walker (2017b) study those attitudes for adult contestants and we will use the corresponding results as one reference point when discussing our findings in Section 3.

In every *Jeopardy!* episode, three contestants compete against each other and up to 61 'clues' appear. One of the show's defining features is that 'clues' are presented as declarative sentences (e.g., *This city is the capital of France*) and contestants have to hit a buzzer to then 'answer' with the corresponding question (e.g., *What is Paris?*). Nevertheless, we will refer to 'answering' or 'responding' to clues throughout the paper to facilitate readability. Whoever hits the buzzer first is entitled to respond and, if correct, the contestant receives the dollar value at stake added to their account balance and is able to select the next clue. That clue is then open to all three contestants and, again, whoever buzzes in first responds. If an answer is incorrect, the clue remains open to the other contestants and the associated dollar value is deducted from the contestant's account balance.

Each episode begins with the *Jeopardy!* round, where six clue categories appear with five clues each, featuring values of \$200, \$400, \$600, \$800, and \$1,000. After these 30 clues, the *Double Jeopardy!* round begins in the same format, but all values are doubled to \$400, \$800, \$1,200, \$1,600, and \$2,000.[5] After the *Double Jeopardy!* round, every episode culminates in one final clue (the *Final Jeopardy!* round), in which each contestant can wager up to their entire account balance on responding correctly. Here again, an incorrect answer leads to a deduction of the wagered amount, whereas a correct answer adds the wagered amount to the contestant's account balance. The goal of the show is to lead the two opponents in account balance after the *Final Jeopardy!* round. We refer the reader to Trebeck and Barsocchini (1990) and Jetter and Walker (2017a,b) for further information on *Jeopardy!*'s general setup.

Finally, it is useful to discuss the selection process of *Jeopardy!* contestants. It would be difficult to argue the kids sample is representative of the *average* 10-12 year olds in the US. Rather, potential contestants need to apply for the show, which indicates (i) they believe to be smart and potentially successful on a game show that rewards knowledge and (ii) they do not shy away from pressure in the form of competing against peers and performing in front of

[5] Note that before November 26, 2001, these values were half, i.e., up to \$500 in the *Jeopardy!* round and up to \$1,000 in the *Double Jeopardy!* round.

millions of television viewers. Any hopeful *Jeopardy!* candidate completes an online exam of 50 clues and promising performers obtaining a high enough score are randomly selected from the pool.[6] As such, this could limit our sample to one that might correspond to those who would one day work in areas and professions where gender gaps in representation and wages have been shown to be larger, such as managerial positions, CEOs, and workers in the finance industry (see Blau and Kahn (2017)). One should keep this aspect of *Jeopardy!* in mind when interpreting our findings and we will come back to this aspect in our conclusion.

2.2 Data

On June 5, 2015, we accessed the *J! Archive* website, a fan-created archive of *Jeopardy!* episodes, to collect information on as many episodes as possible. The sample contains kids episodes from 2000-2014, teenager episodes from 1987-2014, and college student episodes from 1989-2014. The website lists the respective contestants' names, each episode's sequence of clues with clue categories, account balances of each contestant, and detailed information about who responded to a given clue.[7] Most importantly for our purposes, we use information on a contestant's name to conjecture their gender (e.g., Emily is female; Martin is male). In cases where the gender is not immediately obvious, the *J! Archive* website provides pictures for most contestants with the remainder found via web searches for the contestant name and respective episode allowing us to determine their gender.

We focus on four distinct settings: (i) winning an episode, (ii) responding to a clue, (iii) responding correctly to a clue, and (iv) the wagering decision in so-called *Daily Double* (*DD*) clues, which will be explained shortly. We interpret the first three settings as different forms

[6] For the adult episodes, approximately 250,000 people apply every year; 15,000 take the first qualification exam; 1,500 qualify for the show; and 500 eventually become *Jeopardy!* contestants (see Trebeck and Barsocchini, 1990).

[7] Note that we cannot deduct the sequence with which a given clue was responded to. For example, if a clue has been incorrectly responded to by two contestants, we do not know who responded first.

of measuring competitiveness and the fourth setting involving wagering decisions as a choice related to risk-taking.[8] All summary statistics are available in Tables A2 – A4.

First, with respect to winning an episode, our sample includes 62 kids episodes featuring 186 contestants aged 10-12 (with 47.8 percent being female). For episodes featuring teenagers and college students, our database includes information for 202 and 188 episodes, respectively, including 310 and 299 contestants (44.6 percent and 45.1 percent female, respectively). Second, related to whether a contestant responded to a clue or not, our kids sample contains 10,878 observations, whereas the teenage and college student samples include 36,813 and 34,185 observations. Note that each clue produces three observations for this variable, i.e., a binary indicator for answering for each of the three respondents. (If an answer is incorrect, the other contestants can choose to buzz in.) Third, turning to our binary indicator of whether a contestant responded *correctly* to a given clue (conditional on buzzing in), our sample produces 3,716 observations for the kids sample, 12,824 observations for teenagers, and 11,630 observations for college students.

Fourth and final, we now describe the *DD* situation in which we measure wagering decisions. Throughout each *Jeopardy!* episode, three *DD* clues are hidden – one in the *Jeopardy!* round and two in the *Double Jeopardy!* round. The contestant in control of the board who happens to select the clue is able to wager up to their entire account balance on responding correctly.[9] Note that the other contestants are excluded from *DD* clues. In particular, at the time the contestant has to make their wagering decision, they only know the clue category (e.g., *European Cities*), but not the clue. If the contestant answers correctly, they receive the wagered amount toward their account balance, whereas an incorrect answer leads to a subtraction of the wagered amount. Overall, this sample includes 182 observations for the kids sample,

[8]Note that another interpretation of choosing to answer a clue (i.e., 'buzzing in') relates to selection into a competitive environment – an aspect that has attracted its own strand of literature (e.g., see Niederle and Vesterlund, 2007, Croson and Gneezy, 2009, and Gneezy et al., 2009). However, since *Jeopardy!* contestants already applied to be on the show and passed pre-selection, we believe it is more appropriate to interpret 'buzzing in' as behaviour *in* a competitive situation, as opposed to selecting to compete.

[9]More specifically, the respective contestant can wager up to their entire account balance or the largest dollar value on the current board, whichever of the two is greater. This restriction guarantees that even contestants with relatively low account balances can wager non-trivial amounts, i.e., up to $1,000 in the *Jeopardy!* round and up to $2,000 in the *Double Jeopardy!* round.

606 observations for the teenager sample, and 559 observations for college students. Following Säve-Söderbergh and Lindquist (2017) and Jetter and Walker (2017a,b), we analyze the share of the maximum possible wager, i.e., the wagered amount divided by the respective contestant's current score or the largest dollar amount on the board (whichever of the two is greater). Throughout our three samples, the average wagered amount equals \$2,568, \$2,786, and \$2,534 for the kids, teenage, and college samples, respectively. This corresponds to shares of 35.5 percent, 45.1 percent, and 44.4 percent out of the average maximum possible wagers.

2.3 Methodology

After analysing descriptive statistics, we turn to logistic regressions for estimating the likelihoods to (i) win an episode, (ii) respond to a given clue, and (iii) respond correctly. For our fourth setting related to wagering decisions, we employ a standard OLS model to predict the wager as a share of the maximum possible wager. For all outcome measures, we consider the three samples of kids, teenagers, and college students in separate estimations. For example, we predict the wager in clue c for contestant i as

$$Wager_{c,i} = \alpha_0 + \alpha_1 Female_i + \alpha_2 \boldsymbol{X_{c,i}} + \delta_{c,i}, \tag{1}$$

where $Female_i$ constitutes a binary indicator for female contestants. $\boldsymbol{X_{c,i}}$ represents a vector including several control variables that may independently affect a contestant's competitive behaviour and wagering decisions. These variables are also accounted for in the competitiveness settings and include: Binary indicators for black and other non-white races (white serves as the reference point), binary indicators for STEM categories and the 20 most common clue categories, the initial dollar value of the clue, the account balance of the contestant, as well as their account balance relative to their opponents.[10] Finally, $\delta_{c,i}$ represents the usual error

[10]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.

term and throughout our estimations we cluster errors at the player level. We now discuss the intuition of each of these in turn.

2.4 Control Variables

First, Finucane et al. (2000) suggest that risk perceptions could differ by race, prompting us to control for a basic distinction between white (Caucasian), black, and other races. To get this information, we relied on a research assistant who distinguished between black, white, and other races from looking at pictures available on the *J! Archive* website or via internet image searches.[11] All our results are virtually unchanged when ignoring this, perhaps subjectively derived, variable. Second, since STEM subjects continue to be debated in a gender context (e.g., the unusually small share of women in STEM-related fields; see Preston, 1994, Montmarquette et al., 2002, Griffith, 2010, and Buser et al., 2017), it is possible that females and males categorically respond differently to such clues. To control for such dynamics, we manually sorted clue categories into STEM and non-STEM. Third, to control for particularly prominent clue categories that may independently affect competitiveness and risk preferences by gender, we introduce dummy variables for the 20 most common categories. Fourth, Jetter and Walker (2017a) show that the initial clue value can provide an important reference point for a person's wager in *Jeopardy!* – a behavioural concept commonly referred to as 'anchoring' (also see Tversky and Kahneman, 1974, Ariely et al., 2003, Beggs and Graddy, 2009, Furnham and Boo, 2011, and List, 2011).

Fifth, the player's account balance constitutes a measure for their *Jeopardy!* capabilities, as well as their degree of confidence in their performance in the current episode. Sixth, to capture the relative standing of a player with respect to their two opponents, we include a variable relating one's current account balance to their opponents'. Intuitively, prior performance of competitors may influence behaviour in competitive tasks (e.g., see Smith, 2013, for evidence from spelling bee contests). In order to retain all observations, we employ a subtractive formula:

[11]The *J! Archive* website contains photos of the majority of contestants participating in the age limited competitions. For contestants unavailable on the *J! Archive* website, internet image searches were conducted for the respective episode.

$2 \times own\, balance - balance_1 - balance_2$, where subscripts denote opponents.[12] With these parameters in mind, we now turn to describing our empirical findings.

3 Empirical Findings

3.1 Descriptive Statistics

We begin with a comparison of means across gender in Figures 1 – 4, displaying the respective 95 percent confidence intervals. Note that these basic descriptive statistics do not account for the influence of any of the discussed control variables from equation 1. In each graph, we visualise the averages for females on the left-hand side for each age group, whereas the averages for males are shown on the right-hand side. All y-axes are scaled identically within figures to facilitate comparisons. Further, we display means from the analysis of adult *Jeopardy!* contestants presented in Jetter and Walker (2017b) to provide an additional reference point.

In Figure 1, we consider the likelihood of winning a given episode and, overall, no noticeable gender differences emerge. Although females are marginally less likely to win at first glance with means around 30 percent, none of the means are statistically different from each other for any of our three samples. It is of note to see that there is not a statistically meaningful difference within gender or over the age spectrum.

Next, Figure 2 turns to the likelihood of responding to a given clue. Note that confidence intervals are smaller because sample sizes increase substantially once we consider each clue independently. However, we again fail to notice any statistically meaningful differences across gender and even within gender over time. As with the likelihood to win an episode, men are marginally more likely to do so, although all of the respective confidence intervals intersect.

This finding is then incrementally changed when we consider the likelihood to answer correctly in Figure 3. Again, we find no statistically significant differences within cohorts (e.g., comparing the kids' coefficient for females to that of males), but male *teenagers* appear to be

[12] Note that putting one's score into any division-based formula, such as percentage terms, would eliminate those observations where the denominator is equal to zero. In addition, it may distort observations where the numerator takes on the value of zero.

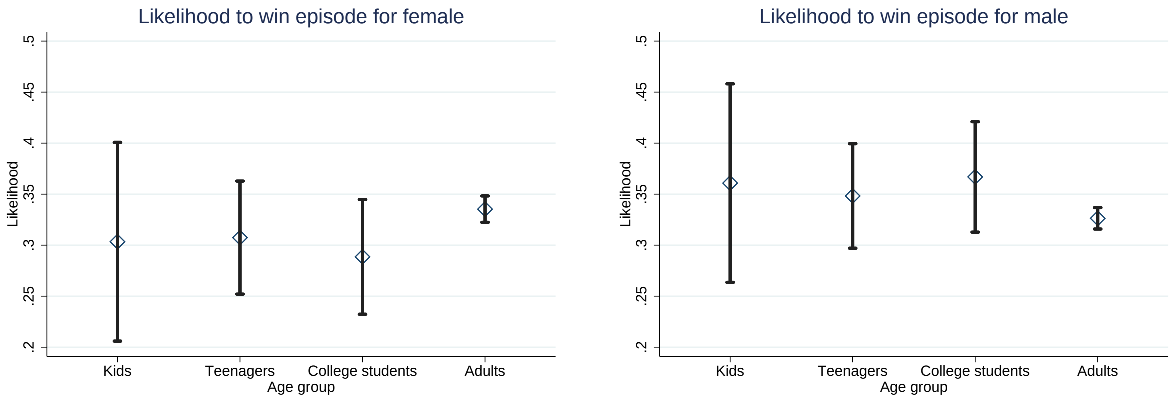

Figure 1: Likelihood to win an episode, displaying means with 95% confidence intervals.

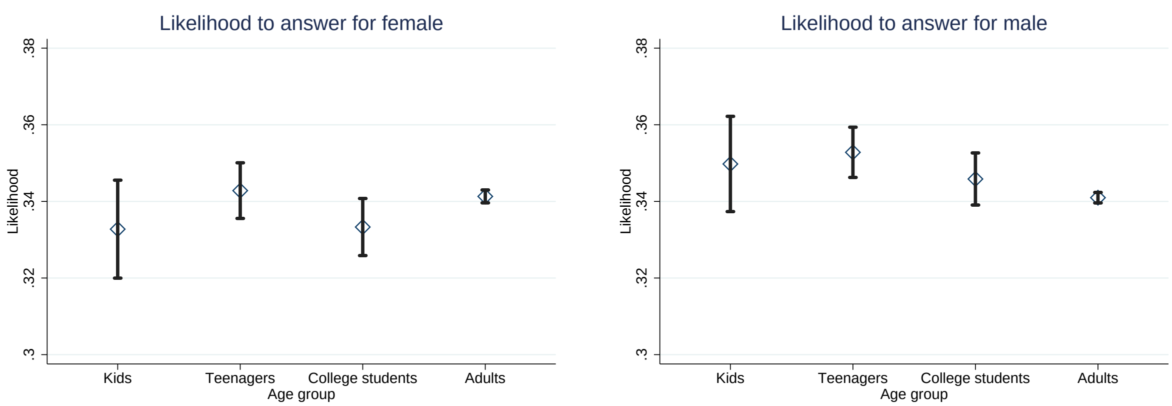

Figure 2: Likelihood to answer a clue, displaying means with 95% confidence intervals.

marginally more likely to respond correctly than male children under the age of 13. Nevertheless, this increased likelihood reverts when we move to college students, so a clear tendency is difficult to infer from Figure 3.

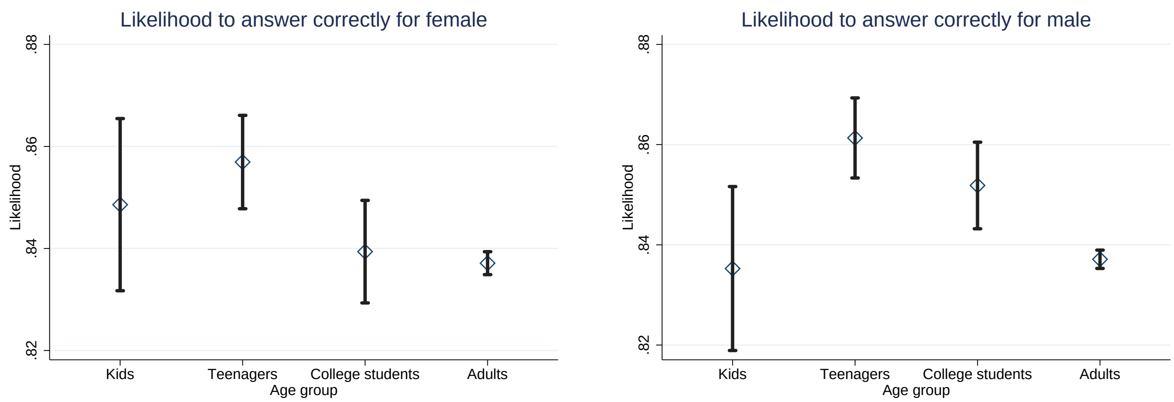

Figure 3: Likelihood to answer a clue correctly, displaying means with 95% confidence intervals.

Finally, Figure 4 considers risk-taking. Recall that prior research has been more decisive in identifying gender differences in risk preferences than in competitiveness across various age groups. Our basic descriptive statistics provide some evidence consistent with the hypothesis that males wager more than females, at least for teenagers and (marginally so) for college students. However, under the age of thirteen, we identify no statistically meaningful gender differences and, if anything, girls are wagering marginally more than boys (37 percent versus 34 percent of the maximum possible wager). After that, female teenagers and college students wager only marginally more than girls – a difference that is again not statistically discernible. Male teenagers and college students, on the other hand, raise their wager substantially when compared to boys, from 34 to approximately 48 and 47 percent. That jump is statistically meaningful.

3.2 Main Regression Results

In Table 1, we document the main results from our regression analyses, following the structure described in Section 2.3. Columns (1) – (4) consider all four settings for the kids sample,

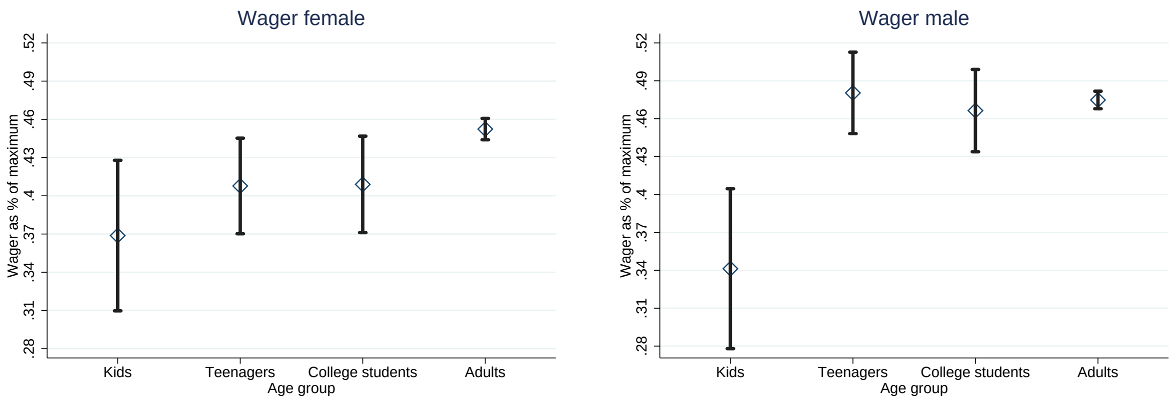

Figure 4: Wagering as share of maximum possible wager, displaying means with 95% confidence intervals.

whereas columns (5) – (8) and (9) – (12) follow the same sequence for the teenager and college student samples. In all estimations, our focus lies on the coefficient associated with the binary identifier for females. Although we control for the covariates introduced in equation 1 throughout settings 2 – 4 in Table 1, the corresponding results are equivalent in statistical terms when excluding them (not displayed but available upon request).

First, and largely confirming the preliminary evidence from Figures 1 – 4, we find little to no gender differences for children in *Jeopardy!*. Only the likelihood to respond is marginally lower for girls than for boys, but the corresponding coefficient is only significant at the ten percent level. In fact, for answering correctly, we even identify a positive coefficient, suggesting that girls may be *more* likely than boys to answer correctly. Nevertheless, the coefficient remains statistically indistinguishable from zero with a t-value of 1.07.

Second, when moving to the teenage sample, we again find no statistically powerful gender differences for our competitiveness settings. All gender coefficients in columns (5) – (7) remain firmly below the commonly accepted minimum threshold level of ten percent significance. However, we do observe the gender gap in risk-taking emerge forcefully, as the corresponding coefficient turns negative and statistically significant on the one percent level. In terms of magnitude, a female teenager wagers 7.3 percentage points less of their available maximum than a

Table 1: Regression results, testing correlations from Figures 1 – 4 when including control variables. Columns (1) – (3), (5) – (7), and (9) – (11) display marginal effects from logistic regressions, whereas the remaining columns show results from OLS regressions.

	Kids				Teenagers				College students			
Dependent variable:	(1) Winning episode	(2) Answering	(3) Answering correctly	(4) Wager	(5) Winning episode	(6) Answering	(7) Answering correctly	(8) Wager	(9) Winning episode	(10) Answering	(11) Answering correctly	(12) Wager
Female	-0.066	-0.023*	0.015	0.030	-0.042	-0.010	-0.006	-0.073***	-0.077*	-0.011	-0.011	-0.052**
	(0.070)	(0.013)	(0.014)	(0.042)	(0.039)	(0.007)	(0.007)	(0.025)	(0.041)	(0.007)	(0.008)	(0.022)
Control variables[a]		yes	yes	yes		yes	yes	yes		yes	yes	yes
# of players	186	186	186	124	310	310	310	254	299	299	299	249
# of episodes	62	62	62	62	202	202	202	202	188	188	188	188
N	186	10,878	3,716	182	606	36,813	12,824	606	561	34,185	11,630	559

Notes: Standard errors clustered on the player level are displayed in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. [a] Includes binary indicators for black and other non-white races, as well as STEM clues and the 20 most common categories, the $ value of the clue, and the account balance of the contestant (both individual and relative to their opponents).

male teenager, holding constant all control variables. Using the average wager for teenagers as a reference point ($6,177), this corresponds to approximately $451.

Third, we observe similar dynamics for college students: Female students wager 5.2 percentage points less than male students, on average, and these respective gender differences are statistically significant at the five percent level. In terms of the competitive settings, we only detect a marginally lower likelihood to win an episode for female students, but no noticeable differences for either the likelihood to answer or to answer correctly.

To better illustrate our findings related to risk-taking in *DD* situations, Figure 5 compares the coefficient related to $Female$ with the magnitudes of other control variables. In particular, we display the derived coefficients from columns (4), (8), and (12) in Table 1 for black contestants, the initial dollar value of the clue, and the contestant's score. For the latter two variables, we display the corresponding magnitude for a one standard deviation increase. To facilitate comparison both within and across cohorts, we again show the three graphs for each age group next to each other with identical scales on the y-axis.

For children, as discussed above, we find no gender differences in wagering behavior. Similarly, we observe no racial differences and the initial dollar value is not a statistically significant predictor of wagering. However, the player's score emerges as a negative and statistically significant regressor, indicating that children take less risk when their score is higher. This may be an intuitive strategy as, all else equal, one may not want to lose a large balance in one bet.

For teenagers, females now wager statistically less than males. This effect is approximately equal to half of a one standard deviation increase in one's score. Finally, turning to college students produces a similar picture, although magnitudes are marginally decreased. Now, being a female translates to approximately 5.2 percentage points less in average *DD* wagers, which is equivalent to marginally less than one third of a one standard deviation of one's score. In dollar terms, this corresponds to approximately $297, since the average wager in the college sample equals $5,707. With these main results in mind, we now turn to analyzing the gender of opponents in our third and final research question.

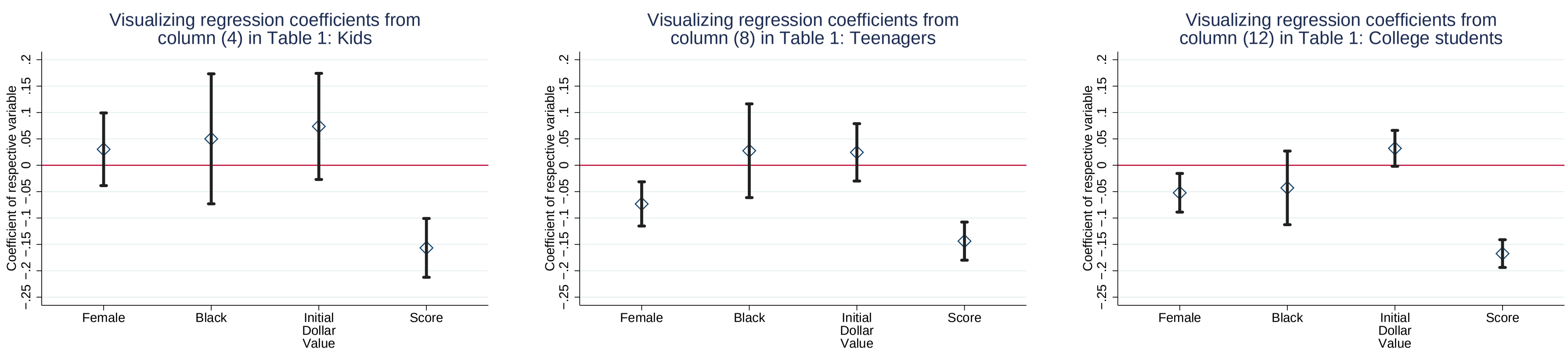

Figure 5: Visualising regression results from columns (4), (8), and (12) of Table 1. Coefficients for the initial dollar value and the contestant's score display magnitudes for a one standard deviation increase of the respective variable.

3.3 The Gender of Opponents

In Tables 2 and 3, we follow the same sequence as Table 1, but split the sample into females and males. Our interest is now whether the gender of one's opposition may influence the discussed competitive measures and risk-taking. All estimations include the same set of control variables discussed in Section 2.3, although all results are consistent when excluding these covariates (results not displayed, but available upon request). In addition, we now include a variable that measures the number of opponents from the opposite sex, i.e., for the female (male) sample we control for the number of male (female) opponents. A priori, if the gender of opponents does not matter, we should expect a statistically irrelevant coefficient in the respective results.

Beginning with the female sample, Table 2 indeed shows no evidence for the hypothesis that females perform or wager differently against males than females. We estimate a null effect in all 12 regressions.[13] These non-results could be surprising since previous studies have suggested females to perform better and take more risk in *single*-sex environments (e.g., see Gneezy et al., 2003, Booth and Nolen, 2012a,b, Lindquist and Säve-Söderbergh, 2011, Booth et al., 2014, or Booth and Yamamura, 2017). Nevertheless, one should keep in mind the different circumstances under which all studies are conducted with most of the corresponding results coming from laboratory experiments in different countries (e.g., Colombia, Israel, Sweden, or the UK). Thus, our results should be seen as complementary insights into whether and how the gender of opponents may affect females' behaviour, especially when looking at a self-selected group of *Jeopardy!* contestants. As such, our results are perhaps comparable to those from De Paola et al. (2015), who study female undergraduate students in Italy and report no differential effects in their performance by the gender of opponents.

Table 3 turns to males and we uncover different dynamics for teenagers and college students. Whereas the gender of opponents does not seem to matter for boys' competitive behaviour and risk-taking, it does seem to affect male teenagers and college students. In particular, each additional female opponent decreases a teenage male's wager by as much as 7.3 percentage

[13]Only the likelihood to answer for girls is suggested to be marginally affected by the presence of boys with a t-value of $\frac{-0.026}{0.018} = 1.44$. However, that remains under the commonly accepted threshold of 1.66 for a ten percent significance.

Table 2: Regression results for the female sample, including the number of male opponents.

	Kids				Teenagers				College students			
Dependent variable:	(1) Winning episode	(2) Answering	(3) Answering correctly	(4) Wager	(5) Winning episode	(6) Answering	(7) Answering correctly	(8) Wager	(9) Winning episode	(10) Answering	(11) Answering correctly	(12) Wager
# of male opponents	-0.097	-0.026	0.004	0.076	0.009	0.003	0.001	0.017	-0.006	0.002	0.011	0.014
	(0.104)	(0.018)	(0.022)	(0.077)	(0.043)	(0.007)	(0.008)	(0.025)	(0.047)	(0.008)	(0.009)	(0.025)
Control variables[a]		yes	yes	yes		yes	yes	yes		yes	yes	yes
# of players	89	89	89	60	153	153	153	116	145	145	145	116
# of episodes	61	61	61	50	179	179	179	136	174	174	174	124
N	89	5,198	1,728	91	270	16,406	5,602	243	253	15,391	5,111	213

Notes: Standard errors clustered on the player level are displayed in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. [a]Includes binary indicators for STEM clues and the 20 most common categories, the $ value of the clue, and the account balance of the contestant (both individual and relative to their opponents).

points. Thus, two female opponents would decrease a male's wager by almost one half of a standard deviation ($0.073 \times 2 = 0.146$ with a one standard deviation increase in wagering equal to 0.31; see Table A3). For college students, that magnitude becomes 5.5 percentage points. These results are, again, not only relevant in statistical terms, but also in economic magnitudes. Further, teenage males are 1.4 percentage points less likely to respond correctly for every female opponent.

Figure 6 visualises the average *DD* wager for each age group by gender and gender of opponents, including the respective 95 percent confidence intervals. Associated regressions that take into account potential effects from our list of control variables produce consistent findings, but we focus on displaying means here because sample sizes become smaller in some instances (e.g., when considering no opponents from the opposite sex). As a reference point, the red horizontal line represents the average wager of contestants from the opposite gender in the same age group. For example, the top left graph considers girls and distinguishes by the number of male opponents in their respective episode. In this case, the horizontal line displays the average wager of boys. For the kids sample, we omit the respective average for zero opponents from the opposite sex since the sample sizes are zero (in case of females) and only three (in case of males). Finally, Figure 6 lists the respective sample sizes below each mean and y-axes for each pair of graphs are identical to facilitate cross-comparisons.

These visualisations again first reveal no gender differences in wagering for children in the top graphs. In particular, we find no statistically discernible differences between any of the four means. However, that changes for the teenage sample in the middle graphs: Males wager significantly more than females when they compete in an all-male field or against one female (as indicated by non-overlapping of confidence intervals with the horizontal red line). However, as soon as a teenage boy is in an otherwise all-female field of competitors, his wagering behavior becomes indistinguishable from that of the average female (as indicated by overlapping of the confidence interval with the horizontal red line). In general, the means for the male teenage sample show larger discrepancies by the number of female opponents than the respective means for the female sample. Moving to the college sample, we observe a similar tendency, as males'

Table 3: Regression results for the male sample, including the number of female opponents.

	Kids				Teenagers				College students			
Dependent variable:	(1) Winning episode	(2) Answering	(3) Answering correctly	(4) Wager	(5) Winning episode	(6) Answering	(7) Answering correctly	(8) Wager	(9) Winning episode	(10) Answering	(11) Answering correctly	(12) Wager
# of female opponents	-0.036	-0.010	0.019	-0.049	0.031	0.002	-0.014**	-0.073***	0.074	-0.006	0.009	-0.055**
	(0.098)	(0.020)	(0.025)	(0.057)	(0.041)	(0.009)	(0.007)	(0.022)	(0.050)	(0.006)	(0.008)	(0.024)
Control variables[a]		yes	yes	yes		yes	yes	yes		yes	yes	yes
# of players	97	97	97	64	157	157	157	138	154	154	154	133
# of episodes	62	62	62	49	189	189	189	170	180	181	181	162
N	97	5,652	1,968	91	336	20,399	7,153	363	308	18,791	6,461	346

Notes: Standard errors clustered on the player level are displayed in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. [a] Includes binary indicators for STEM clues and the 20 most common categories, the $ value of the clue, and the account balance of the contestant (both individual and relative to their opponents).

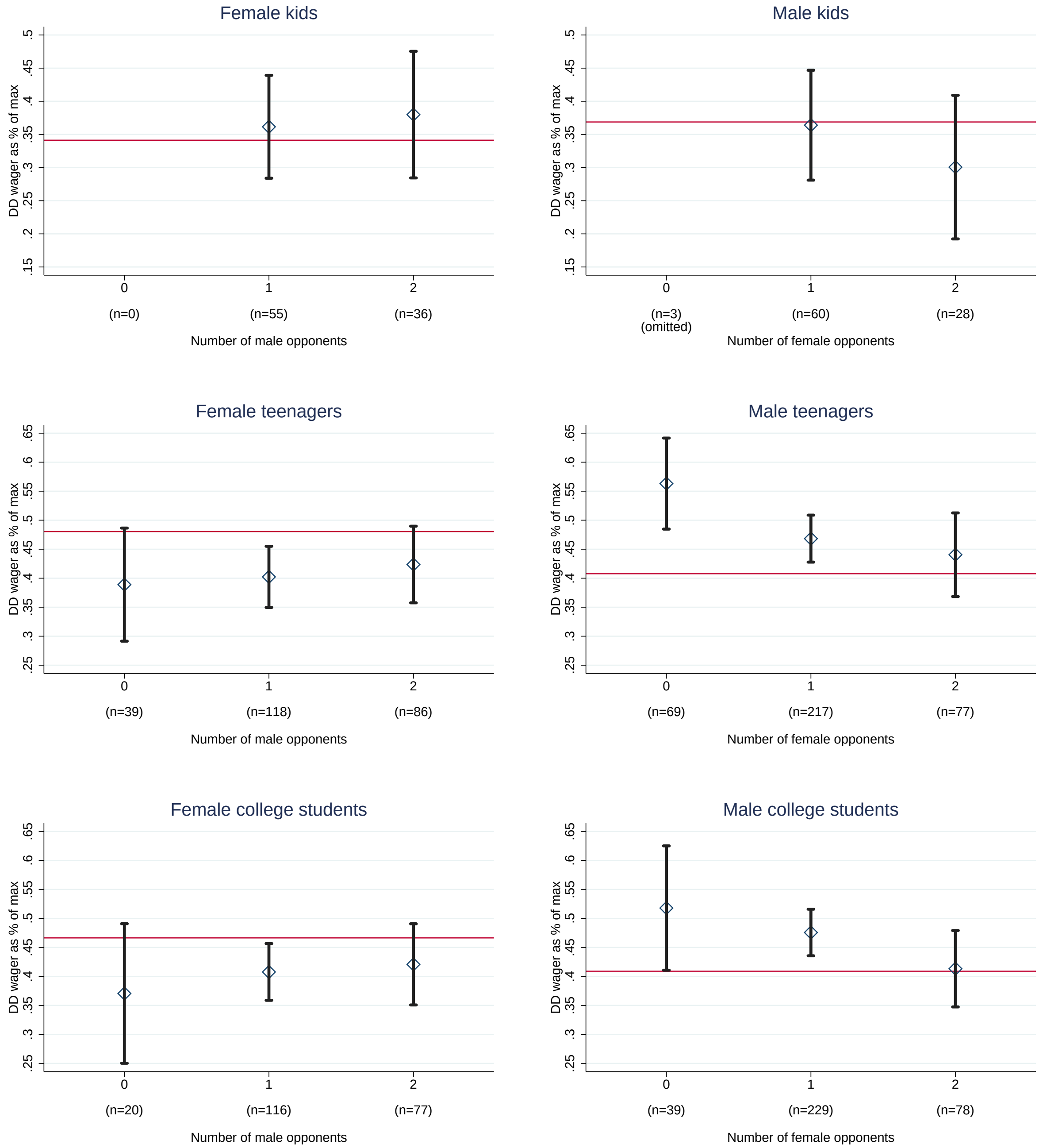

Figure 6: Wagers by number of opponents from the opposite gender. The red horizontal line represents the average wager of contestants from the opposite gender in the same age group.

wagering behaviour is virtually indistinguishable from females' when in an otherwise all-female field of competitors (see the far-right coefficient of the bottom right graph). Put differently, a male college student only wagers significantly more than the average female college student if at least one other male is present.

4 Discussion and Conclusions

In this paper, we use *Jeopardy!* data from the US to investigate at which age (if any) gender differences in competitiveness and risk-taking emerge. We exploit the fact that the show features separate episodes for kids (10-12 years of age), teenagers (13-17 years), and undergraduate college students. Thus, participants across different age groups play by the same rules and compete for identical outcomes in a highly competitive situation in front of millions of television viewers. Our results consistently suggest no gender differences in competitive behaviour across all age groups. This conclusion emerges for the likelihood of (i) winning an episode, (ii) responding to a clue, and (iii) responding correctly to a clue. When it comes to risk-taking, we identify gender differences among teenagers and college students, but *not* among children. In particular, the gender gap emerges forcefully for teenagers, as males begin to wager substantially more, but the wagering of female teenagers does not deviate from that of girls.

Finally, we evaluate whether the gender of opponents (which contestants cannot choose) is able to influence both competitiveness and risk-taking across all three age groups. Females across all age groups appear unaffected by who they compete against. However, male teenagers and college students wager *less* with every additional (exogenously assigned) female opponent. It is possible that the onset of puberty plays a role in these anomalies. In general, one widespread finding in the associated literature suggests that the presence of same-sex peers may result in increased risk-taking (Gardner and Steinberg, 2005; Chein et al., 2011). Alternatively, male *Jeopardy!* contestants may anticipate lower risk-taking by females (Byrnes et al., 1999) and respond by changing their behaviour toward what they perceive the social norm in the presence of females. For instance, Simons-Morton et al. (2005) document less risky driving behaviour by male teenagers when with female passengers and Eckel and Füllbrunn's (2015) findings suggest that inserting more women into the finance industry may reduce overall risk-taking.

Of course, other explanations of our findings are possible and one fruitful avenue for future research may be to try and find settings where one could study the underlying dynamics of whether, how, and why exactly the gender of opponents may influence one's behaviour in competitive situations. Our results here do indicate, however, that gender differences in risk-taking are circumstantial and not present in children before their teenage years. Finally, in the interpretation of our findings, one should not forget the game show setting of *Jeopardy!*. For instance, all contestants have actively selected into being on the show in the US. In the Swedish version of *Jeopardy!*, studied by Lindquist and Säve-Söderbergh (2011) and Säve-Söderbergh and Lindquist (2017), the initial decision to take the qualification exam for kids is made on the school level after receiving a solicitation from the program. Teachers in interested schools administer a qualification test and select competitors for the show based on results. As our results differ from Säve-Söderbergh and Lindquist's (2017) in regard to children's competitiveness, this issue of selection into the competitive environment could be relevant for comparison, in addition to any cultural differences (in this case between US and Swedish adolescents).

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Appendix

Table A1: Recent articles trying to explain the age at which the gender gap in performance and risk attitudes appears (listed chronologically).

Study	*Research Setting*	*Sample*	*N*	*Task*	*Payoffs*	*Main Findings*
Panel A: Gender differences in competitiveness						
Gneezy and Rustichini (2004)	Field experiment	9-10 year olds in Israel	140	Footraces	None	Competition improves performance for boys but not for girls.
Booth and Nolen (2012a)	Lab experiment	UK students near 15 years of age	260	Solving mazes	Average payout 7 pounds	Girls from same sex schools behave more competitively.
Cárdenas et al. (2012)	Field experiment	9-12 year olds in Colombia and Sweden	1240	Running, skipping rope, math and word search	No pay run/skip rope; Math/word search age 7-12 pens/age 12-16 money	Boys and girls equally competitive Columbia. Results mixed in Sweden, girls more competitive some tasks and boys more likely to compete generally.
Andersen et al. (2013)	Field experiment	7-15 year olds in India	318	Throwing balls into buckets	10-30 rupees per shot	Matriarchal society no gender differences emerge with puberty, in patriarchal females less competitive (age 13-15).
Samak (2013)	Field experiment	3-5 year olds in the United States	123	Fishing task	Candy	Boys and girls compete at equal rates. Same gender opponent does not affect performance.
Dreber et al. (2014)	Field experiment	7-10 year olds in Sweden	149 run/146 dance/143 skip rope	Running, dancing, and skipping rope	None	No difference in gender reaction to competition in any task.
De Paola et al. (2015)	Field experiment	Italian undergraduate students	720	Midterm exam	Extra credit added to exam score	Women similar to men regardless of competitor gender and across competitive/non-competitive environments.
Khachatryan et al. (2015)	Field experiment	7-16 year olds in Armenia	824	Skipping rope, math task, and verbal task	No compensation awarded	Girls increase competition more than boys running, no difference in willingness to compete other tasks.
Sutter and Glätzle-Rützler (2015)	Field experiment	3-18 year olds in Austria	Exp 1/2/3 samples 412/441/717	Running task, manual task, math task	Running/manual task pencils, stickers, sweets. Math task cash average 6.58 €.	Running and math perform equally well, manual task girls better than boys. Boys choose competitive payment more often all tasks.
Säve-Söderbergh and Lindquist (2017)	Game show data	10-11 year olds and adults in Sweden	221 10-11 year olds; 448 adults	Swedish Jeopardy! score accumulation and winning contest	Cash prize contestant with highest score at end of match	Girls performed better, were more likely to answer questions correctly, and won more frequently when opponents female.
Panel B: Gender differences in risk taking						
Lindquist and Säve-Söderbergh (2011)	Game show data	Adults in Sweden	316	Point wagers	Cash prize for contestant with highest score at end of match	Females wager 25% less of accumulated score when wagering against all male group, compared to mixed or all female group.
Booth and Nolen (2012b)	Lab experiment	UK students near 15 years of age	260	Coin flip with decision choice affecting payout	Average payout 7 £	Females assume same amount of risk as males when attend same sex school, female only experimental group increases risk taking.
Cárdenas et al. (2012)	Field experiment	9-12 year olds in Colombia and Sweden	1240	Coin flip or safe with varying payouts	Points earned turned into pens and erasers awarded	Boys both countries more risk taking, smaller gap in Sweden.
Booth et al. (2014)	Lab experiment	UK undergraduate students	219	Risk aversion questionnaire	Maximum possible 30 £	Females generally less risk taking, when allocated single sex environment more apt to choose risky situation relative to mixed sex.
Khachatryan et al. (2015)	Field experiment	7-16 year olds in Armenia	824	Coin flip or safe with varying payouts	Points earned for age 7-12 for pens, 12-16 money	Boys more risk taking than girls, dissipates near puberty.
Säve-Söderbergh and Lindquist (2017)	Game show data	10-11 year olds and adults in Sweden	221 10-11 year olds; 448 adults	Point wagers	Cash prize for contestant with highest score at end of match.	No gender gap risk taking at 10-11 years of age. Girls take more risks than women, boys fewer risks than men and women.

Table A2: Summary statistics for kids sample.

	Mean	(Std. Dev.)		Mean	(Std. Dev.)
Panel A: Winning an episode (N = 186)			**Panel B: Answering (N = 10,878)**		
Winning	0.33	(0.47)	Answering	0.34	(0.47)
Female	0.48	(0.50)	Female	0.48	(0.50)
Black	0.10	(0.30)	Black	0.10	(0.30)
White	0.65	(0.48)	White	0.65	(0.48)
Other race	0.25	(0.43)	Other race	0.25	(0.43)
			STEM clue	0.07	(0.25)
			Initial $ value	930.23	(1,013.51)
			$ score	4,711.33	(4,894.24)
			Relative score	0	(9,258.12)

	Mean	(Std. Dev.)		Mean	(Std. Dev.)
Panel C: Answering correctly (N = 3,716)			**Panel D: Wagering Answering (N = 182)**		
Correct	0.84	(0.37)	Wager in % of maximum	0.36	(0.29)
Female	0.47	(0.50)	Female	0.50	(0.50)
Black	0.11	(0.31)	Black	0.12	(0.33)
White	0.64	(0.48)	White	0.63	(0.49)
Other race	0.25	(0.43)	Other race	0.25	(0.44)
STEM clue	0.07	(0.25)	STEM clue	0.10	(0.30)
Initial $ value	1,071.33	(1,556.60)	Initial $ value	1,201.65	(475.41)
$ score	5,241.87	(5,308.33)	$ score	7,252.2	(5,789.95)
Relative score	1,072.56	(9,562.16)	Relative score	4,211.26	(10,683.38)

Table A3: Summary statistics for teenage sample.

	Mean	(Std. Dev.)		Mean	(Std. Dev.)
Panel A: Winning an episode (N = 606)			**Panel B: Answering (N = 36,813)**		
Winning	0.33	(0.47)	Answering	0.35	(0.48)
Female	0.45	(0.50)	Female	0.45	(0.50)
Black	0.07	(0.26)	Black	0.07	(0.26)
White	0.73	(0.45)	White	0.73	(0.44)
Other race	0.20	(0.40)	Other race	0.20	(0.40)
			STEM clue	0.08	(0.27)
			Initial $ value	815.99	(956.46)
			$ score	4,520.35	(4,766.87)
			Relative score	0	(8,516.6)

	Mean	(Std. Dev.)		Mean	(Std. Dev.)
Panel C: Answering correctly (N = 12,824)			**Panel D: Wagering Answering (N = 606)**		
Correct	0.86	(0.35)	Wager in % of maximum	0.45	(0.31)
Female	0.44	(0.50)	Female	0.40	(0.49)
Black	0.07	(0.26)	Black	0.08	(0.27)
White	0.74	(0.44)	White	0.71	(0.45)
Other race	0.19	(0.39)	Other race	0.21	(0.41)
STEM clue	0.08	(0.27)	STEM clue	0.11	(0.31)
Initial $ value	951.31	(1,452.27)	Initial $ value	1,034.16	(509.74)
$ score	4,961.15	(5,054.3)	$ score	6,229.61	(5,175.32)
Relative score	780.91	(8,793.96)	Relative score	2,752.99	(8,905.46)

Table A4: Summary statistics for college sample.

	Mean	(Std. Dev.)		Mean	(Std. Dev.)
Panel A: Winning an episode (N = 561)			**Panel B: Answering (N = 34,185)**		
Winning	0.33	(0.47)	Answering	0.34	(0.47)
Female	0.45	(0.50)	Female	0.45	(0.50)
Black	0.06	(0.24)	Black	0.06	(0.24)
White	0.74	(0.44)	White	0.74	(0.44)
Other race	0.20	(0.40)	Other race	0.20	(0.40)
			STEM clue	0.08	(0.26)
			Initial $ value	783.78	(826.12)
			$ score	4,087.95	(4,325.03)
			Relative score	0	(7,683.90)
Panel C: Answering correctly (N = 11,630)			**Panel D: Wagering Answering (N = 559)**		
Correct	0.85	(0.36)	Wager in % of maximum	0.44	(0.30)
Female	0.44	(0.50)	Female	0.38	(0.49)
Black	0.07	(0.25)	Black	0.07	(0.26)
White	0.74	(0.44)	White	0.74	(0.44)
Other race	0.19	(0.40)	Other race	0.18	(0.39)
STEM clue	0.08	(0.27)	STEM clue	0.09	(0.29)
Initial $ value	883.66	(1,220.24)	Initial $ value	1,007.87	(486.83)
$ score	4,448.91	(4,623.78)	$ score	5,779.79	(4,707.96)
Relative score	723.49	(7,950.65)	Relative score	2,536.91	(7,794.81)