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Article — Published Version

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Managerial and Decision Economics

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Suggested Citation: Sonnabend, Hendrik (2020) : On discouraging environments in team contests: Evidence from top-level beach volleyball, Managerial and Decision Economics, ISSN 1099-1468, Wiley, Hoboken, NJ, Vol. 41, Iss. 6, pp. 986-997, <https://doi.org/10.1002/mde.3153>

This Version is available at:

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RESEARCH ARTICLE

On discouraging environments in team contests: Evidence from top-level beach volleyball

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This contribution empirically investigates the adverse effects of unbalanced competition and negative feedback in team contests in the field. Using a unique data set sourced from top-level beach volleyball, I provide evidence for discouragement effects in line with contest theory. The analysis identifies a non-linear relationship between ex ante contestant heterogeneity and performance. Overall, no gender differences can be found. Finally, it shows that age diversity in teams helps to overcome setbacks.

JEL CLASSIFICATION

C93; D01; D70; J16; Z20

1 | INTRODUCTION

Tournaments among individuals or groups represent an important tool for allocating resources and are therefore prevalent in many economic areas, including labour markets (e.g., team incentives within firms), research and development races, and rent-seeking or lobbying. However, contest theory predicts that unwanted effects may arise when contestants' ability levels are sufficiently heterogeneous or when contestants are exposed to negative feedback. First, greater heterogeneity between players in uneven contests leads to lower aggregate effort (see, e.g., Baik, 1994; Stein, 2002; Szymanski, 2003; Konrad, 2009). Intuitively, the underdog will lower his or her effort as the cost of winning increases (meaning that the effort rent decreases), and this in turn can be anticipated by the favourite. As a consequence, from the tournament organizer's perspective, overall effort falls below the first-best level. Second, performance feedback in a multistage contest like a race produces a similar effect. Because being behind directly diminishes the overall contest rent (see Konrad, 2009, or Malueg & Yates, 2010), feedback is beneficial for the first stage winner but discouraging for the first stage loser.

This paper contributes to the understanding of team performances in discouraging contest environments with a special focus on possible gender effects. Specifically, I empirically investigate the impact of unbalanced contests (i.e., ex ante heterogeneity) and negative feedback (i.e., within game heterogeneity) in the field, using a unique data set taken from professional beach volleyball. This sport offers a

unique setting to answer these questions because it provides three main advantages compared with other team sports: (a) the team size is restricted to two players (with no substitution allowed), (b) players depend greatly on each other due to the consecutive structure of play and the absence of courtside couches, and (c) there are almost no free-riding opportunities due to the small team size.

Both kinds of discouraging effects have been studied empirically in the laboratory setting,¹ as well as in the field,² in most cases, using data from individual contests. On the whole, the results support the theoretical predictions. However, when it comes to performances in group contests, research mostly addresses the free rider or cooperation issue, sharing, and sorting (Sheremeta, 2018). The few empirical studies on the effects of strong–weak match-ups on group efforts give a mixed picture. Although Bach et al. (2009) provide evidence for discouragement using data from Olympic Games regattas, Berger and Nieken (2016) verify a decrease in the intensity of play for favourites—although not for underdogs—in German professional handball when the heterogeneity of strength increases. Regarding feedback in multistage contests, Casas-Arce and Martínez-Jerez (2009) and Delfgaauw et al. (2014) use data from dynamic tournaments among retailer stores to show that trailing contestants either lower their efforts or do not respond to incentives when the gap in performance is sufficiently large. Schneemann and Deutscher (2017) provide further evidence with performance data based on substituted players in German football. Iqbal and Krumer (2019) also highlight the role of intermediate prizes in their data set sourced from team tennis tour-

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naments. On the contrary, Berger and Pope (2011) demonstrate that information about being behind can even motivate individuals and teams and thus positively affect the probability of winning provided that the gap is sufficiently small. I follow this strand of literature and provide further evidence for the existence of these two adverse effects within a fresh data set taken from team contests. In doing so, this study is the first that allows for non-linear effects of ex ante heterogeneity on performance in the empirical analysis.

A further intention of this paper is to highlight the role of gender. When it comes to gender differences in contests, Croson and Gneezy (2009), Niederle and Vesterlund (2011), and Dechenaux et al. (2015) conclude that findings from laboratory and field experiments clearly suggest that “women tend to shy away from competition” and that a “gender gap in performance” exist. Moreover, there is evidence that men have a higher level of confidence and are less vulnerable to setbacks (e.g., Barber & Odean, 2001; Niederle & Vesterlund, 2011).

Still, caution is needed when data are taken from professional sports, because we would expect to find a self-selection of more competitive females here. In addition, contests typically occur as single-sex competitions (Niederle & Vesterlund, 2007). Accordingly, studies on gender difference in professional sports—predominantly performed with data from tennis and focused on performance feedback/momentum—offer mixed results. Although some authors identify significant gender differences in competition to the disadvantage of women (see, e.g., Paserman, 2007; Frick, 2011; Wozniak, 2012; Banko et al., 2016; De Paola & Scoppa, 2017), others do not (Gauriot & Page, 2014; Jetter & Walker, 2015; Krumer et al., 2016; Cohen-Zada et al., 2017; Rosenqvist, 2019). Yet, to the best of the author's knowledge, nothing has been said about possible gender differences when it comes to discouraging situations in group contests. This is surprising because insights from social psychology point to gender difference in group behaviour. For instance, there is evidence for differences in social support, as described, for example, in Eagly (2013). More precisely, studies suggest that women provide better social support and seek it out more often. Thus, this behaviour probably offsets a greater sensitivity to stressful situations. As a hint of the balancing team effect on women's performance under pressure, Toma (2017) finds no gender differences regarding free throw attempts in college and professional basketball.

The remainder of the article is structured as follows. Section 2 gives some background information on beach volleyball. Next, Section 3 describes the data set. Section 4 presents the empirical strategies and the results. Finally, Section 5 concludes with a discussion.

2 | BACKGROUND INFORMATION ABOUT BEACH VOLLEYBALL

According to the *Official Beach Volleyball Rules 2015–2016* of the Fédération Internationale de Volleyball (FIVB, 2014, p. 7), “Beach volleyball is a sport played by two teams on a sand court divided by a net.” After the ball is put into play with a serve, the rally starts. Each team then aims to ground the ball on the opponent's court, having three hits to return the ball. The rally ends when the ball is grounded on (or off) the playing court or when one team commits a fault or penalty. The team winning a rally scores a point (the so-called *rally point system*) and serves to start the following rally. When the receiving

team wins a rally, it gains a point and the right to serve. In this event, the serving player changes. To win the set, 21 points are needed with a minimum two-point lead. For example, when the score is at 20–20, the set continues until a two-point lead is achieved. Finally, the match is won by the team that wins two sets. In the event of a 1–1 tie, a deciding third set is played to 15 points, again with a minimum lead of two points (FIVB, 2014, p. 20).

Unlike other team sports such as basketball, (ice) hockey, or football, substitutions are not allowed. Hence, the players depend greatly on each other: “On the sand, there is no such thing as ‘calling subs’ if you're having a bad day.”³ This dependency is enforced by the structure of play, which implies that consecutive contacts must be made by different players. So a good attack needs good setting, and good setting needs good passing. Finally, there are no courtside coaches. Players, hence, need to decide on tactical adjustments between themselves during timeouts.

Despite the fact that both players can be targeted by the opponent's services and attacks, a tendency for specialization can be observed. This means that a duo consists of a considerably taller player who specializes in blocking and a smaller, more agile player who specializes in defending/digging.⁴

The tournaments covered by the data set are the FIVB Beach Volleyball World Championships held in 2015 in the Netherlands (NED) and 2017 in Vienna (VIENNA) and the Olympic Games in Rio de Janeiro 2016 (RIO). All tournaments had a separate male and a female track and started with a preliminary pool phase followed by an elimination phase for the best teams. RIO additionally offered a lucky loser round.⁵ Needless to say, there were strong incentives to perform well as a good result would be prestigious and of financial importance in terms of prize money, sponsorship, and advertising contracts.⁶

3 | DATA AND DESCRIPTIVE STATISTICS

The data were collected from two sources. First, NED tournament data were provided by the *DataProject s.r.l.* on the FIVB Beach Volleyball World Championships 2015. The company develops software tools to collect sports data, which serves to document and evaluate any action on the pitch. One of these tools was also used to create the official match statistics published on the tournament's website.⁷ Second, the RIO and VIENNA data have been collected from the tournament's official website alone.

Overall, the sample covers 2,206 set–team observations from 478 matches played by 177 teams, of which 89 were male and 88 were female. Table 1 presents some descriptive statistics and gives more information on sets and teams. The points per set that a team scores and the points differential per set (PDIFF) will operate as the dependent variables in the empirical analysis. The probability density function of the variable “points per set” is skewed to the left, which is illustrated by the kernel density estimation presented in Figure 1. Naturally, this is caused by the rules of the game, see Section 2. Given that a two-point lead has been reached, a set ends with 15 or 21 points. In the same way, for PDIFF, observations are clustered at the lower bound because a two-point lead is needed to win a set (see Figure A1).

Next, HET serves as a measure of heterogeneity and is defined as the difference in (ex ante) winning probabilities at match level in absolute

TABLE 1 Summary statistics

Variable		Set 1			Set 2			Set 3		
		N	M	SD	N	M	SD	N	M	SD
Points per set	♂	518	18.861	3.778	518	18.859	3.541	162	13.778	3.011
	♀	438	18.610	4.034	438	18.527	3.972	132	13.068	3.037
PDIFF (abs. values)	♂	259	5.088	3.110	259	5.000	2.915	81	3.728	2.000
	♀	219	5.511	3.379	219	5.566	3.464	66	4.530	2.114
HET	♂	518	0.492	0.286	518	0.492	0.286	162	0.349	0.229
	♀	438	0.490	0.284	438	0.490	0.284	132	0.385	0.021
EPHASE	♂	518	0.394	—	518	0.394	—	162	0.543	—
	♀	438	0.475	—	438	0.475	—	132	0.500	—
HIST	♂	518	3.550	3.427	518	3.755	3.479	162	4.957	3.515
	♀	438	3.397	3.212	438	3.525	3.136	132	3.894	3.396
			N	M	SD					
AGE (years)	♂		89	28.639	3.943					
	♀		88	27.430	3.551					
AGEDIFF (years)	♂		89	3.501	3.481					
	♀		88	3.617	3.652					
HEIGHT (cm)	♂		89	194.135	4.781					
	♀		88	180.347	4.459					
HDIFF (cm)	♂		89	8.876	6.367					
	♀		88	6.966	5.784					

Note. Statistics based on 2,206 observations of 177 teams. ♂: male teams; ♀: female teams.

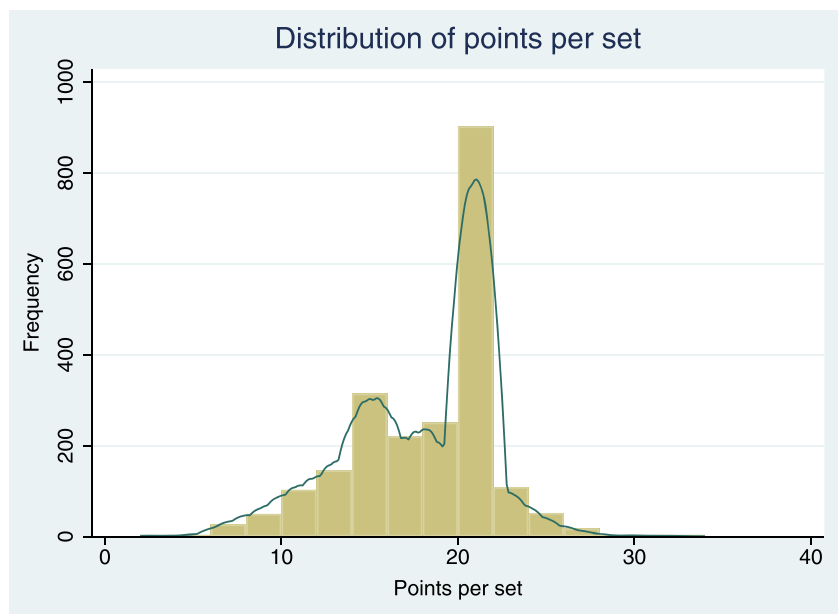


FIGURE 1 Distribution of points per set [Colour figure can be viewed at wileyonlinelibrary.com]

values. Like in, for example, Deutscher et al. (2013) and Bartling et al. (2015), winning probabilities are derived from the betting market.⁸ In detail, $HET = |Pr_i - Pr_j|$, where

$$Pr_i = \frac{1}{1 + \frac{b_i}{b_j}}$$

is the ex ante probability of team i winning the match and b_i (b_j) is the pay-off from betting on team i (j). Pr_j can be determined analogously. Note that $HET \in (0, 1]$, where $HET = 1$ represents the case that no bets are offered for the favourite team, simply because of an overwhelming superiority. This is true for 4.39% of the matches in the sample.

Moreover, EPHASE is a dummy variable that indicates whether or not a match was part of the elimination phase of the tournament. AGE, AGEDIFF, HEIGHT, and HDIFF are team-specific control variables

that refer to a team's mean age, age difference, mean body height, and difference in body heights. It is important to control for physical properties, because there is a strong link to differences in skills and hence to specialization.⁹ In the same way, age diversity might have an impact on performance as well. Although results are mixed from research on differences between mixed-age and same-age work groups in terms of productivity (e.g., Timmerman, 2000, Ilmakunnas & Ilmakunnas, 2011, or Hamilton et al., 2012), insights from the industrial and organizational psychology literature point to better self-regulation skills and greater stress resistance of more experienced workers, marking age-diverse teams appear advantageous in terms of mutual learning and collaboration (Hertel et al., 2013). Additionally, Pelled

et al. (1999) argue that these groups offer less scope for emotional conflicts caused by rivalry.

Finally, to further account for momentum or “hot hand” effects (see, for instance, Bar-Eli et al., 2006, Avugos et al., 2013, or Cohen-Zada et al., 2017), HIST is the sum of sets a team was able to win during a tournament prior to the actual set.

4 | EMPIRICAL ANALYSIS

This study deals with two types of discouraging environments in dynamic contests: unbalanced match-ups and negative feedback. Starting with unbalanced match-ups, I will explain the empirical approach and then present the results.

4.1 | Uneven contests: Discouragement versus ability

If the heterogeneity in abilities is growing, contest theory predicts adverse effects on each player's effort. For instance, Baik (1994) demonstrates that the total effort level of the contestants decreases in response to an increase in the dominance of one player. The intuition is that the underdog will lower his or her effort as the cost of winning increases, and thus, the marginal utility of effort diminishes. As a best response, the favourite reacts by likewise lowering the effort level.

A problem that often arises with field data is that we cannot observe effort directly and, in most cases, must rely on the performance output.¹⁰ Consequently, there is a need to decouple the ability effects from the motivational effects.

One way to deal with the issue is to exploit the fact that increasing asymmetry in abilities affects favourites and underdogs in different ways. As Sunde (2009) has derived in a formal model, the effects of increasing heterogeneity on performance output (e.g., points won in sports) P_i of player i can be separated into a direct “ability effect” and an indirect “discouragement effect”:

$$\frac{dP_i}{d(a_i - a_j)} = \underbrace{\frac{\partial P_i}{\partial (a_i - a_j)}}_{\text{ability effect}} \cdot \underbrace{\frac{\partial P_i}{\partial e_i} \frac{\partial e_i}{\partial (a_i - a_j)}}_{\text{discouragement effect}}, \quad (1)$$

where a_i denotes ability levels and e_i the effort decision of player i . Now the main idea is that both effects work in the same direction for the underdog but in different directions for the favourite: Whereas the discouragement effect lowers the outcome for both players, the ability effect will reduce the underdog's outcome but boost the favourite's outcome. In other words, although the increasing asymmetry in abilities might trigger discouragement and therefore lowers the investment in effort symmetrically, it also implies that it is ceteris paribus easier for the favourite to win against a weaker opponent. Hence, if the empirical analysis suggests that increasing heterogeneity affects underdogs and favourites asymmetrically in that the favourite benefits less than the underdog loses, we can take this as evidence of the discouragement effect.

This approach comes with a caveat, however. When the outcome variable is more or less bounded from above (like in tennis or beach volleyball), increasing superiority might be less visible than increasing inferiority that leads to the problem that the favourites' reactions could be systematically underestimated. For instance, in tennis, no matter how strong the dominance of the favourite is, they cannot score more

than six games per set (given that the two games margin has been reached). To address this issue, Sunde (2009) proposes to restrict the sample to set losers. Still, it is questionable whether these subsamples can be taken as being representative or not.

I circumvent this problem by using point differentials instead of points. The expectations are quite intuitive: Without discouragement, we would expect the point differential (PDIFF) as our measure of performance to be monotonically increasing in the measure of heterogeneity (HET). Although if the discouragement effect exists and is sufficiently strong, the relationship between PDIFF and HET should be nonmonotonic and may even be U-shaped. That would be the case if the discouragement effect dominated the ability effect for favourites at low levels of HET.

Formally, I estimate the model:

$$PDIFF_{sm} = \gamma_0 + \gamma_1 HET_m + \gamma_2 HET_m^2 + \gamma_3 X + \epsilon_{sm}, \quad (2)$$

where the indices s and m refer to set s and match m , respectively, and X is a vector of match-specific and tournament-specific controls including the tournament phase, the set, and tournament fixed effects. Then, ϵ_{sm} is the error term that captures all other effects influencing $PDIFF_{sm}$. Gender-specific regressions are used to identify potential gender differences.

Because it is plausible to assume that the outcomes of the second and third sets might depend on the outcome(s) of the foregoing set(s), the sample is restricted to the first set in the preferred specification. Additionally, Table B1 shows the results for whole sample. Coefficients are estimated with ordinary least squares (OLS) and robust standard errors (clustered on the match level for the whole sample). Finally, to account for the fact that observations are clustered at the lower bound due to the structure of the game (see Section 3), I also estimate a Tobit regression model, see Table B2. The results remain qualitatively unchanged.

4.1.1 | Results

The regression output in Table 2 shows that the relationship between PDIFF and HET is non-linear and convex: The estimated $\hat{\gamma}_1$ and $\hat{\gamma}_2$ differ significantly from zero and show a negative sign and a positive sign, respectively (column 2).¹¹ Furthermore, Figure 2—which illustrates estimated marginal means—indicates that the relationship is indeed U-shaped. That is, whereas the discouragement effect dominates the ability effect for favourites at low levels of HET, the opposite is true when heterogeneity is sufficiently strong. Hence, in line with the theoretical prediction derived from Equation (1), I take this as evidence for the existence of a discouragement effect.¹²

Equation (2) was also estimated separately for male and female teams to check for possible gender differences. Table 2 (columns 3–6) shows that these differences exist, meaning that increasing heterogeneity affects the points differential in sets played by male and female teams differently. However, with similar turning points, Figure 2 suggests that the gender effect relates to lower levels of competitiveness (or “tightness”) in female tournament tracks rather than to differences in the effects of discouragement.¹³ In this context, it is relevant to note that this effect is not induced by the institutional background, as we have identical prize money and the distribution of HET does not differ between male and female teams (two-sample Kolmogorov–Smirnov test, p -value = .552).

TABLE 2 Unbalanced abilities and performance (Set 1 only)

	Model 1	Model 2	Model 1: M	Model 1: F	Model 2: M	Model 2: F
HET	4.377*** (0.556)	-9.927*** (1.843)	4.045*** (0.757)	4.791*** (0.827)	-6.565*** (2.428)	-15.51*** (2.718)
HET ²		14.43*** (1.888)			10.66*** (2.559)	20.64*** (2.660)
EPHASE	-0.210 (0.277)	-0.138 (0.263)	-0.223 (0.374)	-0.207 (0.419)	-0.113 (0.368)	-0.202 (0.377)
Constant	3.206*** (0.349)	5.432*** (0.439)	3.402*** (0.462)	2.984*** (0.545)	5.077*** (0.574)	6.061*** (0.673)
Observations	478	478	259	219	259	219
R ²	.154	.258	.146	.181	.211	.360
Tournament FE	✓	✓	✓	✓	✓	✓

Note. Dependent variable: point differential (Set 1, absolute value). Coefficients are estimated in an ordinary least squares regression framework. Robust standard errors in parentheses.

**p*<.1.
 ***p*<.05.
 ****p*<.01.

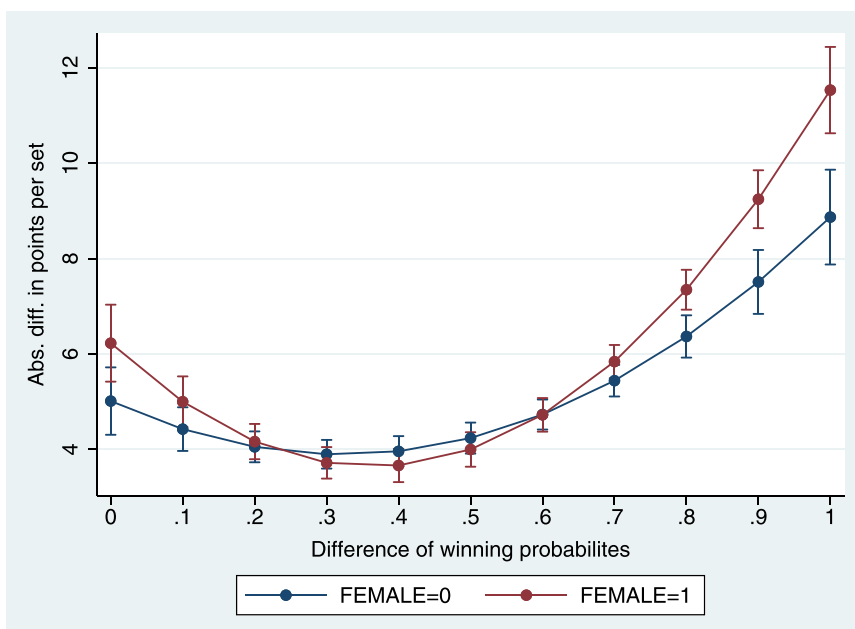


FIGURE 2 Predictive margins (Set 1 only)
 [Colour figure can be viewed at wileyonlinelibrary.com]

4.2 | Discouragement caused by negative feedback

Whereas the previous section dealt with discouragement due to unbalanced match-ups, this section addresses discouragement caused by negative feedback. Generally, in multistage competitions, negative feedback (which is sometimes called negative intermediate information) works as an adversity or a handicap that discourages contestants.¹⁴ A handicap then leads to a downward adjustment of the winning probability, which in turn c.p. reduces the marginal utility of effort. Hence, contestants exposed to setbacks tend to reduce their effort and try to cut their losses. More formally, Konrad (2009) argues that the results of the first stage change the equilibrium efforts in the second stage in a race. Intuitively, this is because the player's contest valuations, being ex ante homogeneous, become asymmetric. Winning the second stage brings the first stage loser back to their initial position, whereas for their opponent, it means winning the whole race.

To capture the effects of negative feedback, I estimate the following model:

$$\begin{aligned}
 PDIFF_{2m} = & \lambda_0 + \lambda_1 SET1LOST_{im} + \lambda_2 FEM \\
 & + \lambda_3 FEM * SET1LOST_{im} + \lambda_4 X + \lambda_5 Y + \epsilon.
 \end{aligned}
 \tag{3}$$

Again, the point differential in the second set of match *m* was used as the dependent variable (*PDIF*_{2*m*}). The main explanatory variable, *SET1LOST*, equals 1 if the first set was lost by team *i* and 0 otherwise. Now if losing the first set decreases a team's subsequent performance, we would expect $\hat{\lambda}_1$ to be negative.¹⁵ Additionally, possible gender differences related to discouragement are captured in the estimated λ_3 .

Furthermore, a large set of controls is used to isolate the effects of negative feedback. *X* is a vector of controls that includes match-specific variables (these are the referee duo [REF1, REF2], the tournament, the tournament phase [EPHASE], and the presence of a home advantage [HOME], and HET), whereas *Y* is a vector of team-specific variables (age, past results in the tournament [HIST],

TABLE 3 Feedback in contests: Ordinary least squares regression

	Basic	HET<HET25	SET CLOSE	SET3	Gender	Age
SET1LOST	-4.857*** (0.358)	-4.492*** (0.615)	-1.410 (0.904)		-4.628*** (0.459)	-5.446*** (0.447)
SET2LOST				-0.654 (0.528)		
FEMALE	-0.706 (0.587)	-1.822 (1.258)	-2.443 (1.960)	1.288 (1.070)	-0.462 (0.663)	-0.775 (0.588)
AGED						-0.603 (0.609)
SET1LOST*FEMALE					-0.490 (0.617)	
SET1LOST*AGED						1.360** (0.623)
Constant	11.55* (6.850)	27.24* (15.10)	35.04 (22.71)	-13.10 (12.17)	11.53* (6.851)	12.44* (6.885)
Observations	951	225	118	293	951	951
R ²	.425	.267	.242	.110	.425	.428
Tournament FE	✓	✓	✓	✓	✓	✓
Sport-specific controls	✓	✓	✓	✓	✓	✓

Note. Dependent variable: PDIFF (point differential in the second set). Coefficients are estimated in an ordinary least squares regression framework. Sport-specific controls: HET, HET², FAV, HIST, AGE, AGEDIFF, HEIGHTDIFF, HEIGHT, HOME, EPHASE, REF1, and REF2. Unfortunately, there are five missings related to the referee variables. * $p < .1$. ** $p < .05$. *** $p < .01$.

favourite status [FAV], and physiological properties). Finally, ϵ is the error term that captures all other effects that influences $PDIFF_{2m}$.

Coefficients were estimated in an OLS regression framework.¹⁶ In the Appendix B, an alternative regression model is provided to check the robustness of the results. Here, $PDIFF_{2m}$ was replaced by the points that team i scores in the second set of a match m , P_{im2} . Because these are non-negative integers with a limited range, I use a multivariable Poisson regression approach (see Karlis & Ntzoufras, 2003, or Cameron & Trivedi, 2010, Chapter 17), which models the log of the expected count (the points per set) as a function of the independent variables.¹⁷ The parameters are estimated using maximum likelihood and robust standard errors clustered at match level. The corresponding marginal effects are presented in Table B3. The main results are preserved.

4.2.1 | Results

First, Table 3 shows that the second set score of a team tends to be lower if the first set was lost (column 1).¹⁸ As a robustness test of this finding, I follow Malueg and Yates (2010) and further control for ability differences by reducing them as far as possible.¹⁹ More specifically, in column 2, the sample is restricted to matches where HET is below the 25th percentile ($HET25$). As a result, the effect is slightly weakened but persists.

Furthermore, the estimated λ_1 is smaller and not different from zero at conventional significance levels if the sample is restricted to matches with a tight first set where the winning team needs a two-point lead (column 3). This suggests that the feeling of being on a par with the opponent creates a positive impact. The coefficient, however, is still negative and just insignificant (given 118 observations). So even losing a tight set has a rather negative effect. On the contrary, losing the second set ($SET2LOST=1$) has no effect on the third set score (column

4).²⁰ This is what conventional contest theory would predict, because the contest valuations are balanced again in the third set.²¹

Second, column 5 reveals that $\hat{\lambda}_3 = 0$, meaning that no gender differences can be found in the reaction to setbacks. This result deserves special attention because it may be taken as a hint for a balancing team effect on women's performances under pressure.²²

Third, column 6 indicates that age-diverse teams do better when facing negative feedback. For the purposes of this article, I define a team as age diverse ($AGED=1$) if the difference in the teammates' ages exceeds 1 standard deviation ($SE = 3.481$ for male teams and $SE = 3.652$ for female teams). This is true for 42.88% of observations. As the estimated coefficient of the interaction term is positive and significantly different from zero, this might suggest that old-young teams tend to be less affected by negative feedback.²³

5 | CONCLUDING REMARKS

This article has studied discouraging effects in group contests using data from professional beach volleyball tournaments. Special attention has been given to the role of possible gender differences. The analysis leads to three main conclusions.

First, there is evidence that discouraging environments in group contests, such as heterogeneity in abilities or negative feedback (i.e., falling behind) and reduce effort levels and performances. This result is in line with the predictions made by contest theory and verifies the general impression derived by empirical research on individual contests and, at least partly, for groups. However, this study is the first to empirically demonstrate a non-linear relationship between ex ante contestant heterogeneity and performance.

Second, no gender difference can be found with respect to the discouraging environments presented. Because this is the first study

of this kind that uses data from group contests, this result suggests that there exists a balancing team effect on women's performances under pressure in high-stake competitions, which might arise from a stronger openness to social support.

Finally, age-diverse teams appear to be less vulnerable to discouragement in the face of setbacks. This is an important finding, because it broadens the scope of the discussion about the advantages and disadvantages of age diversity. Although previous economic research has mainly focused on the effects on productivity and firm performance, my result highlights the advantages of mixed-aged teams in coping with high-pressure situations. I thus strongly recommend that this attribute is considered in the evaluation of age diversity in teams.

ACKNOWLEDGEMENTS

I thank *DataProject*, especially Emilio Spirito, for making data available to me. In addition, I would like to thank Julian Herwig for his assistance in preparing the data set. Finally, I appreciate the helpful comments contributed by an anonymous referee, Ulf Rinne, Thomas Dohmen, Alex Krumer, Christian Deutscher, Sascha Serwe, Mario Lackner, and participants in a seminar at the University of Bamberg and at the SESM conference 2017 as well as the ESEA 2017 meeting.

ENDNOTES

- 1 See, for example, Dechenaux et al. (2015), Hart et al. (2015), March and Sahn (2017).
- 2 See, for example, Ehrenberg and Bognanno (1990), Lallemand et al. (2008), Sunde (2009), Brown (2011), Backes-Gellner and Pull (2013), and Genakos et al. (2015) on uneven contests and Klumpp and Polborn (2006), McFall et al. (2009), Azmat and Iriberry (2010), Tran and Zeckhauser (2012), Banko et al. (2016), and De Paola and Scoppa (2017) on feedback.
- 3 Quote taken from http://www.fivb.org/TheGame/TheGame_BeachVolleyball.htm.
- 4 See, for example, Palao et al. (2008).
- 5 Details on the qualification procedure can be found on the relevant tournament website, <http://netherlands2015.fivb.org>, <http://vienna2017.fivb.com>, and <http://rio2016.fivb.com/en/beachvolleyball>.
- 6 In a personal interview with a professional German beach volleyball player, I was informed that a team's fixed income from sponsorship and other sources generally just covers their large expenses. Teams have to bear enormous travel costs to participate in international tournaments around the world, pay training camps, and hire the "team behind the team" (such as coaches, sports psychologists, physiotherapists, and their management). Consequently, it is the prize money earned during a season that primarily determines the players' income.
- 7 See <http://www.dataproject.com/en/company>.
- 8 The betting odds are collected from oddsportal.com. See, for example, Levitt (2004) and Forrest et al. (2005) for a discussion of betting markets and their efficiency. Klaassen and Magnus (2014) state that compared with the seeding list that the authors used in prior studies "[u]sing betting odds, . . . , appears to be an improvement" (p. 46). Unlike seeding lists and other rankings, the betting market incorporates all the publicly available information near to the date of play, such as injuries or being in poor shape.
- 9 As implied in Section 2, duos with a considerable difference in body size are common in beach volleyball. Whereas taller players are classified as experts at blocking, smaller (and hence more agile) players are experts at digging and passing.
- 10 Exceptions are Berger and Nieken (2016) and Schneemann and Deutscher (2017), who proxy effort by a handball team's number of 2-min suspensions and intensive runs and the running distance in football, respectively.
- 11 Note that the estimated coefficients are jointly significant (p value of .0000).

- 12 Separate regressions for each set suggest that this result is completely driven by Sets 1 and 2. This makes sense because we would expect matches that reach a third set to be more balanced compared with matches that end after two sets. Results can be made available upon request.
- 13 The turning points, given by $HET^* = \frac{\lambda_2}{2\lambda_3}$, are $HET^* = 0.308$ for males and $HET^* = 0.375$ for females.
- 14 Casas-Arce and Martínez-Jerez 2009 (2009, p. 1307) refer to it as "heterogeneity induced by the dynamic nature of multiperiod contests."
- 15 More precisely, a drop in performance in reaction to trailing is not a direct proof of discouragement as we cannot rule out that the effect is completely caused by a positive feedback effect for the leader (Banko et al., 2016). Nevertheless, if a discouragement effect exists, it would imply a negative relationship between losing the first set and the second set outcome. So $\lambda_1 < 0$ can be interpreted as a necessary condition for discouragement caused by negative feedback.
- 16 A Breusch-Pagan/Cook-Weisberg test shows that heteroskedasticity is not a problem in the OLS regression framework.
- 17 Figure A2 allows a comparison of the observed proportions with predicted (Poisson) probabilities. As expected, a strong deviation can be found at 21, which is the natural limit for most sets according to the rules of the game. Notice further that Table 1 indicates that overdispersion is not an issue.
- 18 This result is in line with the observation that the first set lasts significantly longer than the second set, which—beyond increasing mental and physical exhaustion—might be caused by a fading will to win (two-sample Student's t test, p value = .0000). No systematic difference can be found (p value = .1197) regarding the points in Sets 1 and 2. Note that data on set lengths are only available for observations from the NED tournament.
- 19 A discussion of this issue can be found, for example, in Cohen-Zada et al. (2017).
- 20 Because the data do not include intermediate scores, it cannot be ruled out that strategic behaviour might also play a role. That would be the case if the winner of the first set reduces effort after a poor performance in the beginning of the second set to conserve resources for the final set.
- 21 Note that a third set is reached in 30.75% of the matches.
- 22 To exclude that these effects might arise from potential gender differences in how the game is played, which might apply if, for instance, rallies differ in length, note that women's sets do not last longer than men's sets (two-sample Student's t test, p value = .3332). Again, these data are only available for the NED tournament.
- 23 Note that age diversity and favourite status are not correlated at any conventional statistical level.

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How to cite this article: Sonnabend H. On discouraging environments in team contests: Evidence from top-level beach volleyball. *Manage Decis Econ*. 2020;41: 986–997. <https://doi.org/10.1002/mde.3153>

APPENDIX A

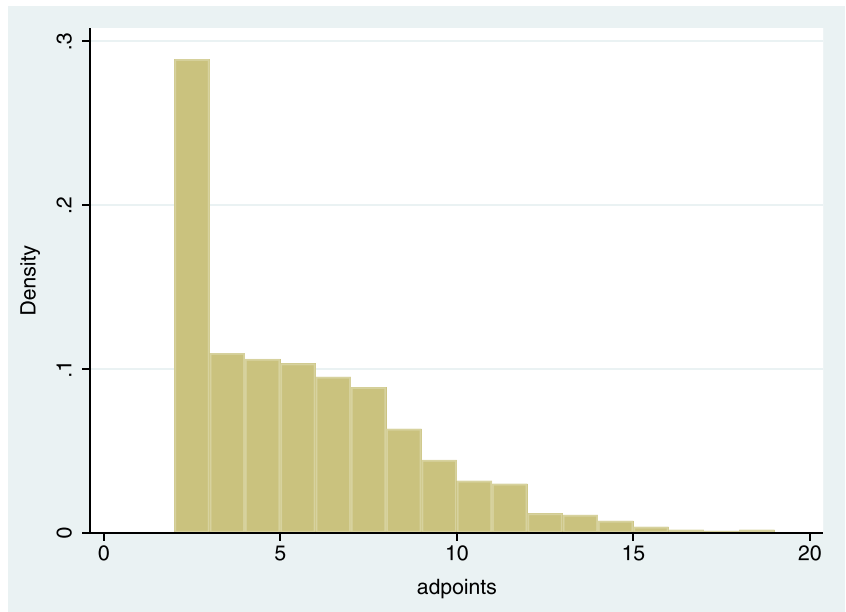


FIGURE A1 Distribution of point differentials [Colour figure can be viewed at wileyonlinelibrary.com]

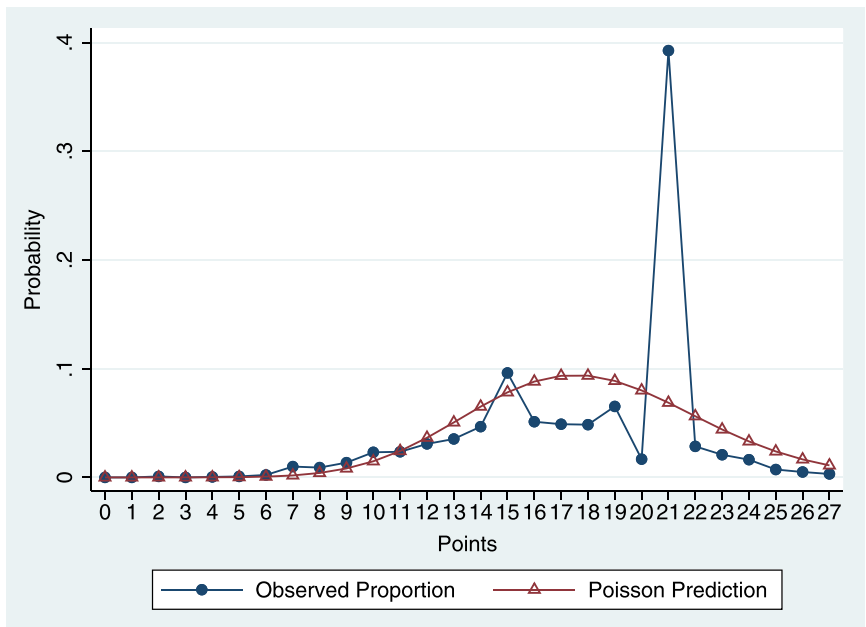


FIGURE A2 Observed versus (Poisson) predicted proportions [Colour figure can be viewed at wileyonlinelibrary.com]

APPENDIX B

TABLE B1 Unbalanced abilities and performance (whole sample)

	Model 1	Model 2	Model 1: M	Model 1: F	Model 2: M	Model 2: F
HET	3.976*** (0.453)	-8.593*** (1.435)	3.415*** (0.601)	4.653*** (0.695)	-6.585*** (1.783)	-12.55*** (2.191)
HET ²		12.89*** (1.535)			10.23*** (1.960)	17.75*** (2.231)
EPHASE	-0.346 (0.210)	-0.278 (0.198)	-0.375 (0.284)	-0.351 (0.319)	-0.295 (0.273)	-0.291 (0.289)
Constant	3.516*** (0.276)	5.424*** (0.336)	3.780*** (0.375)	3.293*** (0.413)	5.314*** (0.430)	5.856*** (0.512)
Observations	1,103	1,103	599	504	599	504
R ²	.153	.242	.147	.180	.214	.314
Tournament FE	✓	✓	✓	✓	✓	✓
Set dummies	✓	✓	✓	✓	✓	✓

Note. Dependent variable: point differential (per set, absolute value). Coefficients are estimated in an OLS regression framework. Robust standard errors (clustered on the match level) in parentheses.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

TABLE B2 Discouragement caused by unbalanced abilities (Tobit regressions, whole sample)

	Model 1	Model 2	Model 1: M	Model 1: F	Model 2: M	Model 2: F
HET	4.984*** (0.577)	-9.564*** (1.906)	4.361*** (0.800)	5.684*** (0.844)	-7.560*** (2.419)	-13.79*** (2.847)
HET ²		14.73*** (1.917)			12.02*** (2.464)	19.86*** (2.782)
EPHASE	-0.466 (0.297)	-0.376 (0.281)	-0.578 (0.431)	-0.393 (0.416)	-0.476 (0.414)	-0.305 (0.378)
Constant	2.428*** (0.391)	4.723*** (0.466)	2.762*** (0.549)	2.187*** (0.555)	4.675*** (0.629)	5.186*** (0.658)
Observations	1,103	1,103	599	504	599	504
Pseudo R ²	.032	.049	.032	.037	.045	.065
Log likelihood	-2,433.456	-2,390.217	-1,272.582	-1,149.973	-1,255.525	-1,116.171
Tournament FE	✓	✓	✓	✓	✓	✓
Set dummies	✓	✓	✓	✓	✓	✓

Note. Dependent variable: point differential (per set, absolute values). Coefficients are estimated in a Tobit regression framework. Robust standard errors (clustered on the match level) in parentheses.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

TABLE B3 Feedback in contests (Poisson regressions)

	Basic	HET<HET25	SET CLOSE	SET3	Gender	Age
SET1LOST	-2.437*** (0.241)	-2.198*** (0.403)	-0.775 (0.561)		-2.293*** (0.298)	-2.827*** (0.297)
SET2LOST				-0.331 (0.338)		
FEMALE	-0.588 (0.373)	-0.205 (0.834)	-0.0668 (1.203)	0.254 (0.642)	-0.447 (0.388)	-0.643* (0.377)
SET1LOST*FEMALE					-0.311 (0.426)	
AGED						-0.486 (0.345)
SET1LOST*AGED						0.906** (0.422)
Observations	951	225	118	293	951	951
Pseudo R ²	.049	.018	.038	.020	.049	.049
Tournament FE	✓	✓	✓	✓	✓	✓
Sport-specific controls	✓	✓	✓	✓	✓	✓

Note. Dependent variable: points in the second set. Coefficients are estimated in a Poisson regression framework. The table presents marginal effects. Sport-specific controls: HET, HET², FAV, HIST, AGE, AGEDIFF, HEIGHTDIFF, HEIGHT, HOME, EPHASE, REF1, and REF2. Robust standard errors in parentheses.

* $p < .1$.

** $p < .05$.

*** $p < .01$.