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Is there no 'I' in team? Strategic effects in multi-battle team competition☆

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ABSTRACT

Individuals may respond differently to their own past performance than to their teammates' performance in a multi-battle competition. Using field data from professional squash team tournaments, we show that while previous individual success begets more success, teammates' past performance has little impact on players' immediate and overall battle performance. It could be argued that players follow the heuristic of doing their best for their teams while at the same time succumbing to a psychological momentum effect, which suggests that responses to their own previous performance depend on the *full* history of previous battle outcomes. Our analysis, however, cannot reject that players are motivated by a strategic momentum effect, which predicts that responses only depend on the current state of battle outcomes irrespective of its precise realization in history.

1. Introduction

Modern economic activities often occur in teams. Individuals working in teams are exposed to much richer information feedback on various aspects of team performance, compared to when working alone. The rich information in teams can lead to more sophisticated incentive problems, and these are the major research topics of organizational economics (e.g., Gibbons & Roberts, 2013). While economic theory has made great advances in understanding these incentive problems, empirical evidence, especially evidence from non-experimental data, is generally lagging behind. In this paper, we exploit a unique field dataset to answer the following question: Do individuals respond differently to teammates' performance than to their own past performance in a competitive setting? Competitions such as sales contests and bonus tournaments are pervasive, and therefore it is important to understand how information feedback in competitions influences motivation and performance (Berger & Pope, 2011; Kuhnen & Tymula, 2012; Lazear & Rosen, 1981).

Our analytical framework and research hypotheses are based on a multi-battle competition between teams and a similar multi-battle competition between individuals (Section 2). In this simplest form, the competition has a best-of-three structure: in a team competition, six players from two competing teams are paired in three pairwise battles; these battles where each pair competes head-to-head are played out sequentially. We refer to the paired players in the first battle as "first movers," pairs in the second battle

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"second movers," and pairs in the third battle "third movers." The winning team is the one that prevails in two battles.[1] In an individual competition, two players play against each other in all three battles. The one who wins two battles emerges victorious. Economic theory has different predictions for the two types of competitions. Whereas individuals do not respond to teammates' performance in previous battles in the team competition (Fu, Lu, & Pan, 2015b), they are fueled by a momentum effect and respond positively to their own success in previous battles in the individual competition (Konrad & Kovenock, 2009). The reason for the different predictions is that individuals have to bear effort costs in a battle. Hence, in order to avoid subsequent costly battles in the individual competition, leaders fight harder in the current battle than laggards.

Apart from the formal theory predicting the neutral response to teammates' performance, economics and psychology literatures provide a wealth of empirical evidence on how social incentives and social comparisons affect performance (Kandel & Lazear, 1992; Zajonc, 1965). For example, individuals may feel averse to being responsible for the team's loss and therefore work harder in teams than when working alone (Chen & Lim, 2013). It has also been shown that simply observing other team members' performance has substantial psychological influences on boosting one's own productivity (Bandiera, Barankay, & Rasul, 2010; Falk & Ichino, 2006; Mas & Moretti, 2009). In Section 2 we propose a few psychological possibilities that might generate non-neutral responses to teammates' performance. For example, individuals with altruistic preferences over teammates' welfare may behave as if they were competing on behalf of their teammates. As a result, it may generate a similar momentum effect as in the individual competition. Furthermore, individuals may simply do their best in the team competition.[2] This can also lead to the neutral response to teammates' performance, although the underlying motive is not strategic.

For the individual competition, while players may be motivated by strategic incentives, there is ample evidence showing that ranking incentives or relative performance feedback can have psychological influences on performance. For example, students who receive the information about how they were performing above (below) the average boost their performance in exams (Azmat & Iriberri, 2010). Other evidence suggests that the response may depend on how much individuals are lagging behind (Berger & Pope, 2011) and their precise positions on the distribution of all players' performance (Gill, Kissova, Lee, & Prowse, 2016). In particular, the positive response to one's previous success, as predicted by the strategic incentives, can also be driven by a psychology momentum effect, which resembles the hot hand hypothesis (Gilovich, Vallone, & Tversky, 1985). In a closely related paper, Malueg and Yates (2010) test whether the momentum effect observed in individual best-of-three tennis matches is strategic or psychological. They find consistent evidence with the strategic momentum effect. Our data allow us to conduct a similar test to tease apart the psychological and strategic explanations. The key observation is that while the psychological effect is path-dependent, the strategic effect is only state-dependent, that is, it does not depend on how the current state is reached by the precise realization of past history. Therefore, by examining the precise impact of past performance on current performance, we can identify the underlying mechanism.

To compare individuals' responses to their own past performance (individual contest) and to their teammates' performance (team contest), we assemble a unique field dataset from professional squash team tournaments (818 team matches). As detailed in Section 3, the structure of a squash team match follows the best-of-three rule. In a squash tournament, after the first battle ends, individual players learn about whether their team is leading or lagging behind. Therefore, we can study how their performance in the second battle responds to their teammates' performance in the first battle. A distinct feature of the squash matches is that each battle is in itself a best-of-five contest between two paired contestants. This means that in addition to examining the overall performance in the second battle, we can also study their immediate performance in the very first period of that battle in response to their teammates' performance. More importantly, the embedded contest structure allows a "within-subject" comparison to the *same* players' performance in the following periods in response to their own performance in the first period. Thus, our empirical strategy is immune to several confounds such as different financial incentives, own and opponent's characteristics, and influences from coaches and audiences. These confounds cannot be avoided if we were to use a separate dataset from individual squash tournaments.

Our analysis generally supports the theoretical predictions (see Section 4). Specifically, we use an instrumental-variables (IV) approach to identify the causal response to teammates' performance because we find strong players tend to team up with other strong players. Our evidence suggests a neutral response: neither second movers' probability of winning the second battle nor their probability of winning the first period of that battle depends on the first battle outcome. Within a battle, however, we find a much stronger and statistically significant positive response to their own success in previous periods: having controlled their abilities, leaders are more likely to win the current period if they have won previous periods.

While these results are consistent with the predictions from a strategic model, one may argue that squash players are simply doing their best for their teams while at the same time succumbing to a psychological momentum effect in response to their own past performance. Our further analysis casts doubt on at least part of this interpretation. In particular, we provide suggestive evidence that the observed momentum effect appears to be only state-dependent: when the current period is a tie-breaker, i.e., the third period following 1:1 and the fifth period following 2:2, we cannot reject that the second movers do not respond to their own performance in previous periods. For example, the fifth period outcomes do not seem to depend on which player has won the first, second, third and fourth periods so long as the score thereafter is equalized. Hence, players' motivations appear more likely to be strategic rather than psychological, consistent with Malueg and Yates's interpretation of the tennis data. Disentangling strategic and psychological

[1] Team contests with such a structure have many real world examples. These include global competitions where multi-national corporations compete for market shares in each region, electoral competitions where rival political parties campaign over legislative seats in each constituency, and R&D competitions between alliances where a project is split and sourced to each member firm within an alliance.

[2] In popular culture, doing your best is often cherished as a good personal trait when working in a team. This expectation culminates in the so-called "There Is No 'I' in Team" slogan in team sports. Such an expectation can evolve to be a norm, which might be enforced by high levels of scrutiny from team coaches and audiences, as Levitt and List (2007, p. 157) put it, "the moral cost of violating a social norm increases as scrutiny …rises."

interpretations is of more than academic interest; it has important implications for team managers and designers of team incentives.

Our findings contribute to the emerging literature on multi-battle team contests (Fu et al., 2015b; Fu, Ke, & Tan, 2015a; Feng & Lu, 2015; Häfner, 2017). To our knowledge, the only previous paper that has empirically studied multi-battle team contests is Fu et al. (2015a), who compare responses to feedback of teammates' performance and to feedback of own performance in best-of-three contests using experimental data. Other than the different data sources, compared to our empirical strategy, their research method is based on a between-subject treatment comparison between best-of-three team contests and best-of-three individual contests. Like us, they confirm the theoretical prediction in team contests; unlike us, they reject the prediction of strategic momentum effects in individual contests and instead find that leaders slack off and laggards work harder. They offer an explanation based on a joy of winning hypothesis, which suggests that every player additionally gains value from winning each single battle. If this psychological value overwhelms the motive of saving on effort costs, leaders will strategically slack off in the second battle in order to play the third battle. One way to square with their results is that while this explanation is likely to hold in a laboratory setting where subjects have low opportunity costs and they may want to gain joy of winning by staying longer in the experiment, it appears less likely in professional sports events where staying longer in the game means a higher chance of injuries, less energy left over for the next match, uncertainty of winning the whole match, and so on. All of these considerations in the field can be internalized in higher effort costs in subsequent periods, thus leading to stronger strategic momentum effects.

Our paper also relates to the vast literature on non-neutral dynamic effects in multi-battle individual contests.[3] Consistent with our study, previous studies using sports data (Malueg & Yates, 2010; McFall, Knoeber, & Thurman, 2009) and lab experiments (Mago, Sheremeta, & Yates, 2013) also find consistent evidence with strategic momentum effects in best-of-($2n+1$) individual contests. For example, Malueg and Yates (2010) exploit the tennis data on close matches between equally skilled players to study individuals' responses to their own past performance. Compared to Malueg and Yates (2010), our data also allow us to compare individuals' responses to their own performance as well as to their teammates' past performance in a similar field setting. It is worth noting that several other studies, including Fu et al. (2015a), find countervailing effects in other field settings (Ferrall & Smith, 1999) and in lab experiments with different setups (Irfanoglu, Mago, & Sheremeta, 2015).[4] For example, Ferrall and Smith (1999) study a best-of-($2n+1$) tournament using field data from professional baseball, basketball, and hockey championships, but they find neutral dynamic effects. They suggest that incentives within teams may have attenuated incentives between teams.

2. Theoretical background

The theoretical predictions of how individuals respond to teammates' performance and to own performance are based on the models of team and individual best-of-three contests (Fu et al., 2015b; Konrad & Kovenock, 2009). We first consider the team contest. Two teams compete in a contest for a final trophy W, which is awarded to each member of the winning team. Six risk neutral players from two competing teams are paired in three pairwise battles, and these battles are played out sequentially. The team that prevails in at least two battles is awarded the trophy.

In each battle, two paired players simultaneously exert efforts, $x_{i(t)}$, $i = A,B$; $t = 1,2,3$, where i denotes the team that a player belongs to and t the participating order. Players' innate abilities, modeled as their constant marginal costs of effort functions, $c_{i(t)}$ for effort $x \geqslant 0$, are allowed to be heterogeneous. All effort cost functions $C_{i(t)}(x) = c_{i(t)} \cdot x$ are common knowledge.

Let $p_i(x_i, x_j)$, $i,j = A,B$; $i \neq j$ denote the probability that player i wins in a battle; $p_A(x_A, x_B) + p_B(x_A, x_B) = 1$. We do not impose a specific functional form for the winning rule in a battle. Like Fu et al. (2015a) and also the most popular contest rules in the literature—lottery rent-seeking contests and all-pay auctions, we assume that the winning rule only has to follow four regularity conditions. First, $p_i(x_i, x_j)$ *increases* in one's own effort, x_i, and *decreases* in the opponent's effort, x_j. Second, *independence*: if a pair equally values winning the battle, there is a unique equilibrium battle outcome, which depends only on the characteristics of effort cost functions of both contenders, and is independent of the common valuation of winning. Third, *monotonicity*: conditional on the effort cost function, higher valuations of winning encourage players to exert greater effort. Fourth, *fairness*: if one player exerts zero effort, the other player wins the battle with any positive effort level; if both players exert zero effort, they win with equal probabilities.

It can be readily inferred from the structure of the game that in each battle, a pair always has the same valuation of winning, irrespective of the outcomes of previous battles. To see this, let's focus on the second movers. First consider the second mover on the leading team (let the leading team be team A). The second mover's "continuation value" from winning her battle is the final trophy—W; her continuation value from losing, causing her team to fight in the third battle, is $W \cdot P_{A(3)}$, where $P_{A(3)}$ represents her third mover teammate's probability of winning the third battle. The net valuation of winning, "effective prize spread," for the second mover on the leading team is, therefore, $W \cdot (1 - P_{A(3)})$. Now consider the opposing second mover on the lagging team B. The second mover's continuation value from winning is $W \cdot P_{B(3)} = W \cdot (1 - P_{A(3)})$, where $1 - P_{A(3)}$ is the complementary probability of winning the third battle by her third mover teammate; her continuation value from losing, causing her team to lose the match, is 0. Thus, the net valuation of winning for the second mover on the lagging team is also $W \cdot (1 - P_{A(3)})$.

[3] See surveys in Konrad (2009, Chapter 8), Konrad (2012), Kovenock and Roberson (2012), Dechenaux, Kovenock, and Sheremeta (2015, Section 4).

[4] More generally, research on interim performance feedback in multi-stage tournaments between individuals often find non-neutral behavioral effects (in both directions) on efforts and outcomes in future stages, in theories (e.g., Ederer, 2010; Goltsman & Mukherjee, 2011; Harris & Vickers, 1985, 1987; Konrad & Kovenock, 2005; Strumpf, 2002), in field studies (e.g., Apesteguia & Palacios-Huerta, 2010; Berger & Pope, 2011; Gauriot & Page, 2014; Kocher, Lenz, & Sutter, 2012; Magnus & Klaassen, 1999; Neugart & Richiardi, 2013; Pope & Schweitzer, 2011) and in (field and lab) experiments (e.g., Berger & Pope, 2011; Deck & Sheremeta, 2015; Eriksson, Poulsen, & Villeval, 2009; Fershtman & Gneezy, 2011; Gill & Prowse, 2012; Girard & Hett, 2013; Kuhnen & Tymula, 2012; Ludwig & Lünser, 2012).

With this observation, player i chooses effort $x_{i(t)}$ to maximize her expected payoff:

$$\pi_{i(t)}(x_{i(t)},x_{j(t)}) = V\cdot Pr(x_{i(t)},x_{j(t)}) - c_{i(t)}\cdot x_{i(t)},$$

where V is the common valuation of winning for both players. Similarly, player j chooses effort $x_{j(t)}$ to maximize her expected payoff:

$$\pi_{j(t)}(x_{j(t)},x_{i(t)}) = V\cdot Pr(x_{j(t)},x_{i(t)}) - c_{j(t)}\cdot x_{j(t)}.$$

In equilibrium, player i chooses effort $x_{i(t)} \in [0,V/c_{i(t)}]$, and player j chooses effort $x_{j(t)} \in [0,V/c_{j(t)}]$. Thanks to the independence condition, in the (stochastic) equilibrium battle outcome, each player's probability of winning the battle is independent of the common valuation of winning, and thus the size of the trophy. Hence, we reach the following hypothesis for how individuals respond to teammates' past performance:

Hypothesis 1 (*response to teammates' performance*). In the second battle of a best-of-three team contest, given second movers' abilities, their performance does not respond to the first battle outcome.

While the standard theory predicts a neutrality result, we entertain some possibilities why individuals may respond to teammates' performance. The first candidate is altruism. In passing, we show that altruistic individuals essentially use the same strategic logic as self-interested individuals in a best-of-three individual contest.

Altruism: altruism implies that players internalize part of the effort costs borne by their team members in the utility evaluations.[5] Conditional on the effort cost functions, this consideration encourages second movers on leading teams to exert greater effort, and discourages second movers on lagging teams. To see this, again let's focus on the second movers. For the second mover on the leading team A, her continuation value from winning is W. However, her continuation value from losing is $W\cdot P_{A(3)} - \alpha c_{A(3)}\cdot x^*_{A(3)}$, where the second term represents the utility loss from the fact that her third mover teammate would have to fight in the third battle and incur an effort cost of $c_{A(3)}\cdot x^*_{A(3)}$; $x^*_{A(3)}$ is the third mover's equilibrium effort and α measures the strength of altruistic preferences of the second mover over the third mover's well-being. The net valuation of winning for the second mover on the leading team is, therefore, $W\cdot(1-P_{A(3)}) + \alpha c_{A(3)}\cdot x^*_{A(3)}$. Now for the opposing second mover on the lagging team B. Her continuation value from winning is $W\cdot(1-P_{A(3)}) - \alpha c_{B(3)}\cdot x^*_{B(3)}$; her continuation value from losing is 0. Thus, the net valuation of winning for the second mover on the lagging team is $W\cdot(1-P_{A(3)}) - \alpha c_{B(3)}\cdot x^*_{B(3)}$.

All else being equal, an altruistic second mover on a leading team has a higher valuation of winning than a selfish one, whereas an altruistic second mover on a lagging team has a lower valuation of winning than a selfish one. Thus, given the monotonicity condition, the altruistic second mover on the leading team exerts greater effort, and the altruistic second mover on the lagging team exerts less effort than the selfish one.

We note that if all players are homogeneous and $\alpha = 1$, the team situation with altruistic second movers is formally equivalent to a best-of-three contest with two individual players. Thus, we have shown a (weaker) form of *strategic momentum effect* in best-of-three team contests with altruistic players, consistent with the similar momentum effect in best-of-three individual contests with self-interested players (Klumpp & Polborn, 2006; Konrad & Kovenock, 2009). The intuitions behind these two momentum effects are also similar: players/teams in the leading position have stronger incentives to win the second battle in order to save on effort costs incurred by themselves/teammates in the otherwise occurring third battle; players/teams in the lagging position have the opposite incentives. These predictions also hold for any best-of-(2n + 1) individual contest. For the sake of exposition, we state the following hypothesis for how individuals respond to their own past performance:

Hypothesis 2 (*response to own performance*). In a best-of-(2n + 1) individual contest, given the two opposing players' abilities, the player who has won the previous battle is more likely to win the next battle.

We also consider two other psychological possibilities.

Differential private valuations of winning: a second mover on a lagging team might have a higher valuation of winning than a second mover on a leading team, because the pivotal status of this battle for the former induces additional psychic values from winning, such as self-image (i.e. self-derived utility of being the "savior" of her team) or aversion to being responsible for the defeat of her team (Charness, 2000; Chen & Lim, 2013; Kandel & Lazear, 1992). Given the monotonicity condition, the second mover on the lagging team would exert greater effort and enjoy a higher probability of winning. Alternatively, a second mover on a leading team might have a higher valuation of winning than a second mover on a lagging team when she derives additional psychic utility from helping her team achieve the final victory. Consequently, she would exert greater effort and be more likely to win.

Subjective (asymmetric) belief updating: upon knowing the outcome of the first battle, the second mover on the lagging team might perceive her third mover teammate as less competitive or skilled than the opposing third mover, and thus she would adjust to a lower valuation of winning. Conversely, the second mover on the leading team might perceive her third mover teammate as more competitive than the opposing third mover. Such a belief updating process leads to a discouragement effect on the lagging team and an encouragement effect on the leading team.

In sum, the standard economic theory predicts that in best-of-three team contests, second movers' performance will not depend on teammates' performance. In best-of-three individual contests, individuals' performance will depend on whether and by how much they have won the previous battles. Other psychological possibilities such as altruism, additional psychic values, and subjective belief

[5] The following logic also applies even if players do not put value on teammates' effort cost per se as long as they value saved effort (and less chance of injuries) which might make the team stronger in the next match.

updating however might lead to the dependence of current performance on teammates' performance, possibly in the same direction of the dependence of current performance on own past performance if, for example, individuals have altruistic preferences.

3. Data: professional squash match

Our data consist of 818 team matches in 31 high-stakes professional squash team championship tournaments during 1998–2014, including Men's World Team Championship, Women's World Team Championship, and Women's European Team Championship.[6] The data include national team matches with game-level scores and monthly updated world rankings for all second movers.[7] All tournaments begin with a qualification stage using a Round-Robin type tournament followed by an elimination stage adopting the Monrad system.[8] This tournament format requires teams to have lots of matches and maintains players' involvement right through to the end of the tournament until a final position is produced for each team. The data include matches from both qualification and elimination stages.

Professional team squash data are particularly suited for our research purpose. A team match follows the same best-of-three rule as in the theory. Each national team normally comprises 3–4 players. Before a match, the identity of players and the order in which they will play in each battle are predetermined and each player can play at most once in a match. By regulations, the three players of each team are nominated by team coaches in order of strength and they are typically paired with the three other players from the opposing team in the same order of strength.[9] Thus, the structure of a team squash match corresponds to the theoretic best-of-three team contest with complete information.[10] An important feature of the squash team matches is that each battle is in itself a best-of-five contest between two paired players, instead of a single-period contest.[11] This provides a crucial leverage to compare responses to teammates' performance and to own past performance. Our analyses will compare second movers' response in the first period of a battle to the first battle outcome and the *same* second movers' response in the following periods to their first period performance.[12] This "within-subject" comparison is immune to several confounds such as different financial incentives, own and opponent's characteristics, and influences from coaches and audiences if we were to use data from individual squash tournaments.[13]

We measure players' abilities using the world rankings statistics, which are based on ranking points earned by players competing in Professional Squash Association (PSA) *individual* tournaments according to how far they advance as well as the prize money. The total number of points a player earns over the previous 12 months is divided by a divisor that increases in the number of tournaments played. The PSA world rankings are then a rank order of average earned points by all players, and are updated monthly.[14] Importantly, the rankings are *only* based on players' performance in individual tournaments and therefore are uncorrelated with their performance in past team tournaments.

Table 1 shows some summary statistics reported separately for each of the three championships. The match ends with a final score of 2:0 in approximately 67.3% of all matches. More 2:0 than 2:1, at first glance, appears to suggest a non-neutral effect, but it might merely reflect that stronger players have better teammates. Therefore, we explore the influence of the within-team ability matching by simulating the match outcomes using the PSA rankings. Based on a simple criterion that the higher-ranked player wins the battle against her paired lower-ranked opponent, we find that the simulated final score is 2:0 in about 72.3% of all matches. Hence, the positively assortative ability matching within a team could confound the evidence of strategic effects, and therefore must be taken into account when performing empirical analyses.

[6] Both World championships are biannual events and the European championship is an annual event. We do not include Men's European Team Championship because this tournament adopts a peculiar "best-of-four" game form with ties broken by points count back.

[7] The data is collected from http://www.squashinfo.com Last time accessed was April 25, 2015. Our raw dataset includes a total of 1619 matches. However, because many matches have missing information on players' world rankings, we only keep those matches in which both second movers' world rankings are recorded for the following analysis. The missing information on rankings is due in large part to the fact some players at the time of playing were not good enough to be ranked in the first place.

[8] The details of the Monrad system are complicated. See its adoption in squash tournaments on the official website of the World Squash Federation. Since we only focus on the dynamics within each team match, the specific format of the tournament is inessential for our analysis.

[9] The regulation dictates that all three nominated players for a match must play in the agreed order of merit (with the opponent team) and the strongest team player must play in the first or second battle. Even so, team coaches may as well assign the players' participation order non-randomly. But the fact that these are determined *before* the match means that the ordering does not alter the prediction of the theory. Furthermore, the main purpose of this paper is to compare individuals' responses to teammates' past performance and to their own previous performance. The "within-subject" empirical strategy we use is not affected by non-random assignment of players before the match starts.

[10] It is conceivable that teammates who often attend training camps together before a major tournament may know about the competence of each other more accurately than players from rival teams. If this superior knowledge implies deviations from players' skill levels as reflected at current world rankings, this fact will alter strategic neutrality. However, since in the professional squash world there are much more individual tournaments on which rankings are based, the concern about "hidden" information of players' competence does not appear to be warranted in reality.

[11] Each period of the best-of-five individual contest is played to 11 points. The player who scores 11 points first wins the period except that if the score reaches 10:10, the period continues until one player leads by two points.

[12] While the theory prediction of response to teammates' performance, i.e., Hypothesis 1, concerns second battle outcomes, the same logic applies to the very first period of a second battle because the material incentives of winning remains unchanged.

[13] One of the influences from team coaches is that players may have incentives other than short run tradeoff between effort cost and probability of winning if they might be put on the bench in the next match if they do not perform well in the current match. We however emphasize that our empirical strategy focuses on the comparison within a match, wherein a player faces the same out-of-the-match incentives at every stage of his/her match.

[14] Our dataset only contains the world rankings statistics, not the ranking points behind those statistics.

Table 1
Actual and simulated match outcomes.

	Men's World	Women's World	Women's European
No. of matches	361	228	229
Actual			
% of matches with a final score of 2:0	69.3	67.5	64.3
Simulated			
% of matches with a final score of 2:0	72.0	76.0	69.2

Note: Simulated final scores are calculated based on a simple criterion: the player with higher ranking wins in each battle. The final score is then produced by adding up the wins and loses from those battles.

4. Results

In this section, we first examine second movers' immediate and overall battle performance in response to teammates' performance, that is, the first battle outcome. In particular, we take into account unobserved characteristics for players from the same team by employing an IV approach. Next, we consider the same second movers' response to their own performance within a battle. To not double count the data, only one second mover in each battle can be used in the analysis. We choose higher-ranked second movers as a consistent way to analyze the data. Using lower-ranked second movers simply produces a mirror image of the analysis and does not change any conclusion.

4.1. Response to teammates' performance: single equation models

As the dependent variable, we measure second movers' immediate performance by whether they won the first period of the second battle; and their overall battle performance by whether they won the second battle. We use the following specification to estimate the effect of the first battle outcome on each of the two performance metrics:

$$Performance_{2(ms)} = \beta_0 + \beta_1 Leading_{(ms)} + \beta_2 RatioRank_{2(ms)} + \delta + \epsilon_{(ms)}, \tag{1}$$

where the dependent variable is the higher-ranked second mover's performance metric in match m of tournament s. The indicator variable $Leading_{(ms)} = 1$ if the first mover teammate won the first battle in match m of tournament s, and zero otherwise. $RatioRank_{2(ms)}$ represents the second movers' ability differential, measured by the ratio of the ranking of the higher-ranked second mover and that of his/her paired lower-ranked second mover (e.g., if a seventh ranked player competed against a tenth ranked player, the variable takes a value of 7/10). $RatioRank_{2(ms)}$ imposes a restriction on the second movers' ability differential to adjust for potential biases induced by a positive correlation in rankings between team members. δ allows nonlinear specifications of $RatioRank_{2(ms)}$ and the home advantage of whether the higher-ranked second mover's team played on the home field, the neutral field or the opponent field (with the opponent field providing the omitted category). $\epsilon_{(ms)}$ is the error term. The equations are estimated using a probit model with a robust variance estimator that is clustered at the tournament event level (totalling 31 events).

Table 2 reports estimates of the average marginal effects of Eq. (1) for second movers' immediate (1–3) and overall battle (4–6)

Table 2
Second movers' immediate and overall battle performance in response to first battle outcome: single-equation estimates.

	Average marginal effects (S.E.)					
	(1)	(2)	(3)	(4)	(5)	(6)
Leading	0.144***	0.078**	0.068*	0.139***	0.052	0.047
	(0.032)	(0.034)	(0.035)	(0.028)	(0.032)	(0.033)
$RatioRank_2$		−0.400***	−0.902*		−0.512***	−1.367**
		(0.044)	(0.522)		(0.028)	(0.567)
$RatioRank_2(squared)$			0.159			1.295
			(1.119)			(1.194)
$RatioRank_2(cubic)$			0.382			−0.535
			(0.811)			(0.768)
Home			0.171			0.039
			(0.105)			(0.091)
Neutral			0.041			−0.032
			(0.073)			(0.060)
N (matches)	818	818	818	818	818	818

Note: In (1)–(3), the dependent variable is whether winning the first period. In (4)–(6), the dependent variable is whether winning the second battle.
*p < 0.10, **p < 0.05, ***p < 0.01.

performance, respectively. Columns (1) and (4) show that the coefficient estimate of *Leading* is highly significant ($p < 0.001$) in the full sample when second movers' ability differentials are not controlled, reminiscent of assortative ability matching within a team as presented in Table 1. When we control second movers' ability differentials in columns (2) and (4), the coefficient estimate of *Leading* becomes much smaller. While it remains statistically significant for immediate performance in the first period, it is not significant for overall performance in the second battle. Unsurprisingly, the coefficient estimate of $RatioRank_2$ suggests that the second movers' probability of winning becomes larger the weaker their opponent is. The results are virtually unchanged when we additionally control nonlinear terms of $RatioRank_2$ and home advantage; none of these variables are significant.

4.2. Testing for selectivity bias

The results presented in Table 2 appear to suggest that, while the second movers' immediate performance positively responds to the first battle outcome, the response of their overall battle performance tapers away. One important concern however is that there may exist some unobserved characteristics of a team that influence all of its players' performance such that being in a leading position is correlated with these unobserved variables. The unobserved characteristics may include team morale and training status at the time of the match. As a consequence, if we do not treat the variable *Leading* as endogenous, we may have overstated the effect of being on a leading team on the second mover's performance. Given the above single equation estimates, this implies that the coefficient of *Leading* may have a smaller size and even a negative sign.

To properly deal with the selection problem on the unobservables, we estimate an IV model by using $RatioRank_1$ (the ranking ratio of the first mover teammate and the paired first mover) to instrument *Leading*. The IV results rest on the premise that $RatioRank_1$ is a valid instrument. To be so, the excluded instrument must satisfy that (i) it strongly influences the prospect of winning the first battle, and (ii) conditional on $RatioRank_2$ it is uncorrelated with the error term in Eq. (1). It is easy to show the first qualification. In a probit model that explains the probability of winning the first battle, the coefficient estimate of $RatioRank_1$ is highly statistically significant ($p < 0.001$). The second qualification can also be confirmed by including $RatioRank_1$ in Eq. (1). If the excluded instrument can only influence the probability of winning the first period or the second battle through the channel of whether being on the leading team or not, then its estimated coefficient in the single equation model should be insignificant. This is indeed the case (winning the first period: $p = 0.356$; winning the second battle: $p = 0.903$).[15]

Formally, following Eq. (1), the endogenous variable *Leading* can be written as

$$Leading_{(ms)} = \gamma_0 + \gamma_1 RatioRank_{1(ms)} + \gamma_2 RatioRank_{2(ms)} + \delta + \pi_{(ms)}, \tag{2}$$

where all the covariates except $RatioRank_{1(ms)}$ are the same as in Eq. (1) and $\pi_{(ms)}$ is an error term. To allow for the possibility that the unobserved determinants of a first battle outcome and the unobserved determinants of a second battle outcome are uncorrelated, we assume that $\pi_{(ms)}$ and $\epsilon_{(ms)}$ are distributed bivariate normal, with $E[\pi_{(ms)}] = E[\epsilon_{(ms)}] = 0$, $var[\pi_{(ms)}] = var[\epsilon_{(ms)}] = 1$ and $cov[\pi_{(ms)}, \epsilon_{(ms)}] = \rho$. $RatioRank_{1(ms)}$ serves as an excluded instrument that provides an identification for the system consisting of Eqs. (1) and (2). Because both dependent variables are dichotomous, the likelihood function corresponding to all four possible states of the world is therefore a bivariate probit.

Table 3 reports the maximum likelihood bivariate probit estimates. The results show that in all specifications where we control $RatioRank_2$, the estimate of the average marginal effect of *Leading* is statistically insignificant, and in fact has a negative sign for both second movers' immediate and overall battle performance.[16] This suggests that the endogeneity problem does exist and it has a similar effect on our estimates as the assortative ability matching within a team. Once we have taken into account both issues, we fail to detect that the second movers respond to their first mover teammates' performance.

4.3. Response to own past performance

As discussed earlier, a unique feature of the squash data is that each battle is in itself a best-of-five contest. It allows us to do a "within-subject" comparison between their immediate first period performance in response to teammates' performance and their performance in subsequent periods in response to their first period performance. The evidence presented above has shown that second movers' performance in the first period of a battle does not respond to teammates' performance. However, if second movers are motivated by strategic momentum effects where they want to save on costly effort, we will observe positive performance responses in subsequent periods to the success in the first period.

We use the following specification to estimate the effect of previous period outcome on second movers' performance in subsequent periods:

$$Win_{2(ts)} = \alpha_0 + \alpha_1 WonPeriod_{2(ts)} + \alpha_2 RatioRank_{2(ts)} + \delta + \nu_{2(ts)}, \tag{3}$$

where the dependent variable is an indicator variable: $Win_{2(ts)} = 1$ if the higher-ranked second mover won the *t*th period of battle *k* in tournament *s*, and zero otherwise. $WonPeriod_{2(ts)}$ calculates the number of periods the high-ranked second mover has won so far before the *t*th period of battle *k* in tournament *s*. $RatioRank_{2(ts)}$ represents the second movers' ability differential, measured by the ratio of the

[15] It should be noted, however, that this is not a formal test if the single equation model is misspecified. But it does give us a clear indication of the patterns in the data. Also, given the independent nature of battles, it is implausible that conditional on second movers' ability differential, the first movers' ability differential will directly affect the outcome of the second battle before the first battle ever begins.

[16] A more straightforward two-stage least squares (2SLS) model one could estimate by treating the two dependent variables as continuous gives similar results.

Table 3
Second movers' immediate and overall battle performance in response to first battle outcome: IV estimates.

	Average marginal effects (S.E.)					
	(1)	(2)	(3)	(4)	(5)	(6)
Leading	0.168**	−0.042	−0.074	0.217***	−0.004	−0.024
	(0.074)	(0.103)	(0.105)	(0.053)	(0.083)	(0.089)
$RatioRank_2$		−0.485***	−2.353***		−0.539***	−2.276***
		(0.069)	(0.694)		(0.065)	(0.803)
$RatioRank_2(squared)$			2.968**			3.046*
			(1.443)			(1.699)
$RatioRank_2(cubic)$			−1.301			−1.565
			(0.933)			(1.078)
Home			0.235**			0.119
			(0.110)			(0.108)
Neutral			0.077			−0.003
			(0.076)			(0.069)
ρ	−0.115	0.201	0.258	−0.250**	0.091	0.129
	(0.120)	(0.184)	(0.199)	(0.120)	(0.194)	(0.211)
N (matches)	563	563	563	563	563	563

Note: In (1)–(3), the dependent variable is whether winning the first period. In (4)–(6), the dependent variable is whether winning the second battle. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

ranking of the higher-ranked player and that of the paired lower-ranked opponent. δ allows nonlinear specifications of $RatioRank_{2(ts)}$ and the home advantage of whether the higher-ranked second mover's team played on the home field, the neutral field or the opponent field (with the opponent field providing the omitted category). $\nu_{2(ts)}$ is the error term. All equations are estimated using a probit model with a robust variance estimator that is clustered at the tournament event level.

Within a battle, we can examine dynamic effects at the second, the third, and the fourth periods. *WonPeriod* can take on the value of 0 or 1 at the beginning of the second period, 0, 1 or 2 at the beginning of the third period, and 1 or 2 at the beginning of the fourth period.[17] Note that *WonPeriod* captures the current state within a battle. However, in order to test whether the performance responds to the precise past history, we also estimate an alternative specification in which we use indicator variables for whether the high-ranked second mover won in each of the previous periods, thereby allowing for a finer examination of dynamic effects between periods.

Table 4 reports estimates of the parameters in Eq. (3). The results show a positive and significant impact of *WonPeriod* on the probability of winning the current period, be it the second, third or fourth period. In particular, second movers' probability of winning the second period increases by 23.8% if they have won the first period. This estimate is statistically significant and economically large compared to their performance in the first period in response to the first battle outcome. Furthermore, estimates from columns (3) and (5) show that the momentum effect occurs at every period, meaning that each additional victory in the previous periods contributes to a higher probability of winning the current period.

Table 4 does not help tell apart whether the momentum effect is strategic or psychological. The two effects however have different predictions concerning the third and fifth periods. If the momentum effect is strategic or state-dependent only, then when faced with a tied situation, the performance in the third or fifth period will not depend on whether they have won the previous period. However, if the momentum effect is psychological or path-dependent, then the performance will depend on whether they have won the previous period even in a tied situation. Given this observation, we re-estimate the model for the third and fifth periods for a subsample where these periods are tie-breakers.[18]

Table 5 reports the results. We find that in both the third and fifth periods, none of the previous period outcomes have a statistically significant impact on the current period outcome. This suggests that the performance in these tie-breaking periods appears to be only state-dependent, thus consistent with strategic momentum effects. In particular, comparing column (1) of Table 5 and column (3) of Table 4, we find that the impact of the second period performance is much smaller in the magnitude in the tie-breaking situation.

4.4. Discussion

Here, we discuss some caveats about the results. First, the small number of observations in the tie-breaking situation might raise concerns for the power of our test to reject the null. We conducted a power analysis on the effect reported in Table 5. For the estimated effect in the third period to reach a significant level of 5% and a power of 70% in a two-tailed test, the required sample size is 16,062. This number way exceeds our full sample size, which is 818, suggesting that the test here might be underpowered. We also

[17] The fifth period is a case where *WonPeriod* is always 2.
[18] This is also the identification strategy adopted by Malueg and Yates (2010, pp.691-692).

Table 4
Second movers' performance response to their own past performance.

	Average marginal effects (S.E.)				
	(1) 2nd Per.	(2) 3rd Per.	(3) 3rd Per.	(4) 4th Per.	(5) 4th Per.
WonPeriod	0.238***	0.136***		0.122***	
	(0.040)	(0.018)		(0.045)	
Won the 1st Per.			0.138***		0.078
			(0.020)		(0.060)
Won the 2nd Per.			0.134***		0.132**
			(0.029)		(0.053)
Won the 3rd Per.					0.171***
					(0.054)
$RatioRank_2$	−1.130**	−0.127	−0.128	−0.413	−0.507
	(0.525)	(0.521)	(0.522)	(1.422)	(1.436)
$RatioRank_2(squared)$	1.693	−0.768	−0.765	0.183	0.331
	(1.243)	(1.170)	(1.173)	(3.187)	(3.232)
$RatioRank_2(cubic)$	−1.061	0.640	0.636	−0.086	−0.137
	(0.826)	(0.752)	(0.754)	(2.090)	(2.124)
Home	−0.020	0.067	0.066	0.066	0.078
	(0.079)	(0.081)	(0.081)	(0.129)	(0.126)
Neutral	−0.043	0.035	0.035	0.047	0.051
	(0.057)	(0.055)	(0.055)	(0.116)	(0.108)
N (matches)	817	784	784	302	302

Note: $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 5
Second movers' performance response to their own past performance when the current period is a tie-breaker.

	Average Marginal Effects (S.E.)	
	(1) 3rd Per.	(2) 5th Per.
Won the 2nd Per.	−0.026	−0.142
	(0.047)	(0.138)
Won the 3rd Per.		−0.140
		(0.120)
Won the 4th Per.		−0.102
		(0.111)
$RatioRank_2$	−2.017	−1.624
	(1.297)	(1.914)
$RatioRank_2(squared)$	3.664	2.886
	(2.995)	(3.979)
$RatioRank_2(cubic)$	−2.512	−1.872
	(2.045)	(2.478)
Home	0.141	−0.335
	(0.209)	(0.269)
Neutral	0.138	−0.199
	(0.131)	(0.147)
N (matches)	199	117

conducted the same power analysis on the effect reported in Table 4. It shows that for the estimated effects in the third period to reach a significant level of 5% and a power of 70% in a two-tailed test, the required sample size is 910. This suggests that using a sample with its size close to our full sample, which is sufficiently large to detect the momentum effect in all periods, we still cannot reject the absence of the momentum effect in the tie-breaking period. Put differently, other than concluding that our test might be underpowered, we have some confidence to say that the null result is probably true.[19]

Second, we note that if a player's strength or physical ability is correlated with their ability to handle pressure, then the team might put the strong player in the second battle (though there is only limited room to do so; see Footnote 9). Given this possibility, we

[19] Putting confidence on the null result poses an inherent difficulty to any statistical tests, since statistical tests as well as power analyses are designed to put confidence on a non-neutral effect. Take the following thought experiment. Suppose we find an effect that is very close to zero and the power analysis shows that we need a million observations to detect such an effect. Without a prior of whether the effect is true or not, we can conclude either that the test is underpowered (if the prior is that the effect is true) or that the effect probably does not exist (if the prior is that the effect is false).

must be cautious when interpreting the neutrality result in players' response to their teammates' performance. Nevertheless, since the main interest of this paper is to compare players' responses to teammates' performance and to their own performance, our "within-subject" empirical strategy is not affected by the non-random assignment of players.

5. Conclusion

Individuals working in teams are exposed to richer information feedback compared to when working alone. This fact gives rise to not only more sophisticated economic incentives problems but also greater opportunities of psychological influences. In this paper, using the squash data, we have examined how people respond differently to teammates' past performance than to their own previous performance. We use a "within-subject" empirical strategy to cleanly identify these two responses. We find that while second movers do not respond to teammates' past performance, they respond strongly to their own past performance.[20]

The economic models of best-of-three team and individual contests provide a parsimonious candidate explanation for our findings. However, finding evidence consistent with the theoretical predictions does not necessarily mean that players are using game-theoretic reasoning while playing their matches. For example, players may simply try to do their best in team matches while at the same time succumbing to a psychological momentum effect during their own battle. While this interpretation may seem quite plausible, our analysis for the individual matches suggests that players are not mindlessly doing their best without responding to any strategic incentives. In particular, our evidence does not support that individual performance within a battle is driven by the psychological momentum effect. The suggestive evidence on strategic responses to own past performance is also consistent with previous works using different data sources (Mago et al., 2013; Malueg & Yates, 2010).

While differentiating between economic and psychological interpretations of our findings may seem rather innocuous from a practical perspective, we argue that a more accurate understanding of team members' motivations is essential for team managers to engineer more effective incentive packages. For instance, it might be ill-advised by suggesting that managers should carefully distribute the kind of information feedback to team members. The usual argument is that stressing own previous performance too often would backfire for some members as they might lose momentum in their work, whereas stressing other teammates' performance would be more likely to be universally effective in boosting motivation and performance. Given our findings, however, this piece of advice would not work since whether or not people lose momentum cannot be easily changed by the information feedback. To control that, managers need to consider economic incentive problems too. After all, there is often an 'I' in team.

Appendix A. Additional tables

Tables A1 and A2.

Table A1
Third movers' immediate and overall battle performance in response to first battle outcome: single-equation estimates.

	Average marginal effects (S.E.)					
	(1)	(2)	(3)	(4)	(5)	(6)
Leading	0.061	0.079	0.089	0.008	0.021	0.026
	(0.066)	(0.058)	(0.055)	(0.067)	(0.218)	(0.067)
$RatioRank_3$		-0.568^{***}	-6.865^{***}		-0.482^{***}	-3.408^{*}
		(0.101)	(2.068)		(0.131)	(0.567)
$RatioRank_3(squared)$			11.178^{***}			4.997
			(3.931)			(3.765)
$RatioRank_3(cubic)$			-5.921^{***}			−2.532
			(2.245)			(2.278)
Home			−0.046			0.047
			(0.175)			(0.198)
Neutral			−0.108			0.056
			(0.138)			(0.120)
$N(matches)$	183	183	183	183	183	183

Note: In (1)–(3), the dependent variable is whether winning the first period. In (4)–(6), the dependent variable is whether winning the third battle. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

[20] As a robustness check, we also conduct the analogous analysis for the third movers. Tables A1 and A2 in Appendix A report the results. Similar to the second movers, the third movers do not significantly respond to their teammates' past performance, but they significantly respond to their own past performance. (Note that this evidence is only suggestive as there are much fewer observations for the third movers.)

Table A2
Third movers' performance response to their own past performance.

	Average marginal effects (S.E.)				
	(1) 2nd Per.	(2) 3rd Per.	(3) 3rd Per.	(4) 4th Per.	(5) 4th Per.
WonPeriod	0.134^{**}	0.154^{***}		0.333^{***}	
	(0.060)	(0.037)		(0.071)	
Won the 1st Per.			0.176^{***}		0.319^{***}
			(0.052)		(0.097)
Won the 2nd Per.			0.132^{*}		0.275^{***}
			(0.071)		(0.097)
Won the 3rd Per.					0.389^{***}
					(0.087)
$RatioRank_3$	-3.906^{**}	0.776	0.806	1.492	0.851
	(1.986)	(1.619)	(1.614)	(3.613)	(3.683)
$RatioRank_3(squared)$	6.734	−2.788	−2.834	−2.541	−1.261
	(4.303)	(3.220)	(3.220)	(6.976)	(7.104)
$RatioRank_3(cubic)$	−3.634	2.013	2.039	1.081	0.331
	(2.659)	(1.918)	(1.922)	(4.028)	(4.112)
Home	0.193	−0.097	−0.092	−0.028	−0.004
	(0.180)	(0.181)	(0.181)	(0.258)	(0.259)
Neutral	0.097	−0.101	−0.096	0.189	0.200
	(0.108)	(0.138)	(0.134)	(0.188)	(0.188)
$N(matches)$	183	183	183	93	93

Note: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

References

Apesteguia, J., & Palacios-Huerta, I. (2010). Psychological pressure in competitive environments: Evidence from a Randomized Natural Experiment. *American Economic Review, 100*, 2548–2564.
Azmat, G., & Iriberri, N. (2010). The importance of relative performance feedback information: Evidence from a natural experiment using high school students. *Journal of Public Economics, 94*, 435–452.
Bandiera, O., Barankay, I., & Rasul, I. (2010). Social incentives in the workplace. *Review of Economic Studies, 77*, 417–458.
Berger, J., & Pope, D. (2011). Can losing lead to winning? *Management Science, 57*, 817–827.
Charness, G. (2000). Responsibility and effort in an experimental labor market. *Journal of Economic Behavior and Organization, 42*, 375–384.
Chen, H., & Lim, N. (2013). Should managers use team-based contests. *Management Science, 59*, 2823–2836.
Dechenaux, E., Kovenock, D., & Sheremeta, R. M. (2015). A survey of experimental research on contests, all-pay auctions and tournaments. *Experimental Economics, 18*, 609–669.
Deck, C., & Sheremeta, R. M. (2015). *Tug-of-war in the laboratory* <http://ssrn.com/abstract=2658795>.
Ederer, F. (2010). Feedback and motivation in dynamic tournaments. *Journal of Economics and Management Strategy, 19*, 733–769.
Eriksson, T., Poulsen, A., & Villeval, M. C. (2009). Feedback and incentives: Experiment evidence. *Labour Economics, 16*, 679–688.
Falk, A., & Ichino, A. (2006). Clean evidence on peer effects. *Journal of Labor Economics, 24*, 39–57.
Feng, X., & Lu, J. (2015). *Effort-maximizing contingent prize allocations in sequential three-battle contests.* National University of Singapore.
Ferrall, C., & Smith, A. A. (1999). A sequential game model of sports championship series: Theory and estimation. *Review of Economics and Statistics, 81*, 704–719.
Fershtman, C., & Gneezy, U. (2011). The tradeoff between performance and quitting in high power tournaments. *Journal of the European Economic Association, 9*, 318–336.
Fu, Q., Ke, C., & Tan, F. (2015a). "Success Breeds Success" or "Pride Goes Before a Fall"?: Teams and individuals in best-of-three contests. *Games and Economic Behavior, 94*, 57–79.
Fu, Q., Lu, J., & Pan, Y. (2015b). Team contests with multiple pairwise battles. *American Economic Review, 105*, 2120–2140.
Gauriot, R., & Page, L. (2014). *Does success breed success? A quasi-experiment on strategic momentum in dynamic contests*, QuBE Working Papers No. 28.
Gibbons, R., & Roberts, J. (2013). *The handbook of organizational economics.* Princeton University Press.
Gill, D., Kissova, Z., Lee, J., & Prowse, V. (2016). *First-place loving and last-place loathing: How rank in the distribution of performance affects effort provision*, IZA Discussion Paper No. 9286.
Gill, D., & Prowse, V. (2012). A structural analysis of disappointment aversion in a real effort competition. *American Economic Review, 102*, 469–503.
Gilovich, T., Vallone, R., & Tversky, A. (1985). The hot hand in basketball: On the misperception of random sequences. *Cognitive Psychology, 17*, 295–314.
Girard, Y., & Hett, F. (2013). *Competitivenss in dynamic group contests: Evidence from combined field and lab data*, Gutenberg School of Management and Economics Discussion Paper No. 1303.
Goltsman, M., & Mukherjee, A. (2011). Interim performance feedback in multistage tournaments: The optimality of partial disclosure. *Journal of Labor Economics, 29*, 229–265.
Häfner, S. (2017). A tug of war team contest. *Games and Economic Behavior, 104*, 372–391.
Harris, C., & Vickers, J. (1985). Perfect equilibrium in a model of a race. *Review of Economic Studies, 52*, 193–209.
Harris, C., & Vickers, J. (1987). Racing with uncertainty. *Review of Economic Studies, 54*, 1–21.
Irfanoglu, Z. B., Mago, S. D., & Sheremeta, R. M. (2015). *The new Hampshire effect: Behavior in sequential an simultaneous election contests* <http://ssrn.com/abstract=2477457>.
Kandel, E., & Lazear, E. P. (1992). Peer pressure and partnerships. *Journal of Political Economy, 100*, 801–817.
Klumpp, T., & Polborn, M. K. (2006). Primaries and the new Hampshire effect. *Journal of Public Economics, 90*, 1073–1114.
Kocher, M. G., Lenz, M. V., & Sutter, M. (2012). Psychological pressure in competitive environments: New evidence from a randomized natural experiment. *Management Science, 58*, 1585–1591.
Konrad, K. A. (2009). *Strategy and dynamics in contests.* New York, NY: Oxford University Press.

Konrad, K. A. (2012). Dynamic contests and the discouragement effect. *Revue d'Economie Politique, 122*, 233–256.
Konrad, K. A., & Kovenock, D. (2005). *Equilibrium and efficiency in the tug-of-war*, CESifo Working Paper Series No. 1564.
Konrad, K. A., & Kovenock, D. (2009). Multi-battle contests. *Games and Economic Behavior, 66*, 256–274.
Kovenock, D., & Roberson, B. (2012). Conflicts with multiple battlefields. In M. R. Garfinkel, & S. Skaperdas (Eds.). *The Oxford handbook of the economics of peace and conflict*. New York, NY: Oxford University Press.
Kuhnen, C. M., & Tymula, A. (2012). Feedback, self-esteem, and performance in organizations. *Management Science, 58*, 94–113.
Lazear, E. P., & Rosen, S. (1981). Rank-order tournaments as optimum labor contracts. *Journal of Political Economy, 89*, 841–864.
Levitt, S. D., & List, J. A. (2007). What do laboratory experiments measuring social preferences reveal about the real world? *Journal of Economic Perspectives, 21*, 153–174.
Ludwig, S., & Lünser, G. K. (2012). Observing your competitor – The role of effort information in two-stage tournaments. *Journal of Economic Psychology, 33*, 166–182.
Magnus, J. R., & Klaassen, F. J. G. M. (1999). On the advantage of serving first in a tennis set: Four years at Wimbledon. *Journal of the Royal Statistical Society: Series D (The Statistician), 48*, 247–256.
Mago, S. D., Sheremeta, R. M., & Yates, A. (2013). Best-of-three contest experiments: Strategic versus psychological momentum. *International Journal of Industrial Organization, 31*, 287–296.
Malueg, D. A., & Yates, A. J. (2010). Testing contest theory: Evidence from best-of-three tennis matches. *Review of Economics and Statistics, 92*, 689–692.
Mas, A., & Moretti, E. (2009). Peers at work. *American Economic Review, 99*, 112–145.
McFall, T. A., Knoeber, C. R., & Thurman, W. N. (2009). Contests, grand prizes, and the hot hand. *Journal of Sports Economics, 10*, 236–255.
Neugart, M., & Richiardi, M. G. (2013). Sequential teamwork in competitive environments: Theory and evidence from swimming data. *European Economic Review, 63*, 185–205.
Pope, D. G., & Schweitzer, M. E. (2011). Is Tiger Woods loss averse? Persistent bias in the face of experience, competition, and high stakes. *American Economic Review, 101*, 129–157.
Strumpf, K. S. (2002). Strategic competition in sequential election contests. *Public Choice, 111*, 377–397.
Zajonc, R. (1965). Social facilitation. *Science, 149*, 269–274.