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# Driven to Win: Rivalry, Motivation, and Performance

Gavin J. Kilduff<sup>1</sup>

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## Abstract

This article investigates the phenomenon of interindividual rivalry and its consequences for motivation and task performance. Two studies of adults from the general population found that rivalry, as compared to nonrival competition, was associated with increased motivation and performance, controlling for tangible stakes, dislike, and other factors. Then, a large-scale archival study of long-distance running found that runners ran faster in races featuring their rivals, which were identified through empirical observation of demographics and prior race interactions. This research extends existing theory on competition and motivation and represents a first exploration into the consequences of rivalry between individuals.

## Keywords

rivalry, rivals, competition, motivation, performance, relationships

Rivalry adds so much to the charms of one's conquests.

—Louisa May Alcott

Rivalry among scholars advances wisdom.

—Hebrew Proverb, Babylonian Talmud

Anecdotal evidence of the power of rivalry is widespread, be it in athletics (Magic Johnson–Larry Bird), business (Bill Gates–Larry Ellison), or science (Antoine Lavoisier–Joseph Priestly). Across these and other examples, rivalry seems to instill a drive to perform that goes beyond simple competition over tangible stakes. However, scientific inquiry into rivalry is scant. This article investigates interindividual rivalry and its consequences for motivation and performance. I argue that in any competitive environment, from the workplace to the classroom, competitors may develop rivalry relationships that increase motivation to win above and beyond objective stakes.

## Competition Versus Rivalry

Competition has historically been defined as a situation in which actors' outcomes are opposed—the gain of one comes at the loss of the other (Deutsch, 1949; Kohn, 1992; Scherer & Ross, 1990; Stanne, Johnson, & Johnson, 1999). Thus, competition is a characteristic of the situation; it exists when actors must vie for scarce resources. This work has taught us much about the nature of competition; however, it has largely neglected to consider the role of relationships between competitors and, by extension, rivalry. The word rivalry is used occasionally as a synonym of such “structural” competition (James & Greenberg, 1989; Wankel, 1972); however, equating the two

may fail to capture rivalry's true essence. For example, how do we explain the fierce competitiveness that still rages between Pete Sampras and Andre Agassi, a decade after any stakes-based competition between them and even during matches staged purely for charity?<sup>1</sup> In real-world rivalries, there seems to be a relationship and history between the competitors which motivate them beyond tangible stakes.

## Rivalry as a Competitive Relationship

The topic of rivalry as something more than structural competition has just recently begun to receive attention from researchers. One article examined rivalry in college basketball and found that it correlated with teams' similarity, proximity, and histories of competition; further, games between rival teams were more defensive (Kilduff, Elfenbein, & Staw, 2010). Another observed heightened testosterone levels in soccer players prior to facing a “fierce” versus a “moderate” rival (Neave & Wolfson, 2003). Here, I explore whether rivalry can develop between individuals and how it affects motivation and performance.

I follow Kilduff, Elfenbein, and Staw (2010) in conceptualizing rivalry as a relationship between a focal actor and target actor that is characterized by heightened psychological stakes for the focal actor in competitions against the target actor,

<sup>1</sup> New York University, New York, NY, USA

### Corresponding Author:

Gavin J. Kilduff, New York University, 44 W. 4th St., New York, NY 10002, USA.  
Email: gkilduff@stern.nyu.edu

independent of the objective characteristics of the situation (e.g., tangible stakes). By psychological stakes, I mean the subjective importance placed upon competitive outcomes (i.e., win or loss). Importantly, rivalry is not wholly distinct from competition. Rivals are inherently actors in competition but also more than that due to their history and ongoing relationship. Rivalry differs from traditional conceptions of competition because (1) it entails a focus on a specific other competitor with whom the focal actor has a relationship (as opposed to anonymous, unfamiliar, or undifferentiated opponents); (2) it takes into account the past interactions of competitors; (3) it suggests that the psychological stakes of competition can vary according to these relationships and interactions, independent of tangible stakes. It is also worth noting that rivalry may be asymmetric—one side might feel rivalry without reciprocation, although this may be relatively uncommon (see Kilduff et al., 2010 for further discussion)—and that rivalry and liking are considered orthogonal factors (rivals may be liked or disliked, as may nonrivals).

### Rivalry, Effort, and Performance

Research on the effects of competition on motivation and performance dates back to Triplett (1898) who observed that bicyclists were faster when directly competing than when racing alone or with a noncompetitive pacesetter. Since Triplett, such research has yielded mixed findings (see Epstein & Harackiewicz, 1992; Murayama & Elliot, 2012 for reviews). Some studies have similarly linked competition to improved motivation and performance (e.g., Erev, Bornstein, & Galili, 1993; Scott & Cherrington, 1974; Tauer & Harackiewicz, 1999, 2004), while others argue that it hurts motivation and performance because it is experienced as controlling (Deci, Betley, Kahle, Abrams, & Porac, 1981; Deutsch, 1949; Kohn, 1992; Reeve & Deci, 1996; Vallerand, Gauvin, & Halliwell, 1986).

Various factors may help to explain these mixed findings, including individual differences (Epstein & Harackiewicz, 1992; Murayama & Elliot, 2012) and task interdependence (Miller & Hamblin, 1963; Stanne et al., 1999). However, one important factor has gone overlooked: competitors' relationships with one another. In lab studies of competition, relationships are removed by matching participants with anonymous or unfamiliar opponents (e.g., Deci et al., 1981); in field studies, any existing relationships typically go unmeasured (e.g., Tauer & Harackiewicz, 2004). This is despite the fact that two prominent theories within social psychology, social comparison theory (Festinger, 1954) and self-evaluation maintenance theory (Tesser, 1988), both posit the importance of relational factors to motivation (similarity and closeness).

Here, I propose that the motivational and performance consequences of competition vary by the relationship between competitors—in particular, by the level of rivalry between them. Research on Tesser's self-evaluation maintenance model finds that individuals are more competitive with friends than strangers, provided the task is relevant to their self-concept (e.g., Tesser & Smith, 1980). This may be because we have enduring relationships with our friends, making them more frequent

targets of social comparison (Festinger, 1954; Mussweiler & Rüter, 2003). Similarly, rival competitors with whom we have a history of competing—and perhaps an expectation of future competition with—may elicit greater social comparison concerns, thus ramping up motivation. In addition, relatedness more generally is posited as a fundamental need that can drive motivation (Deci & Ryan, 1985). Rivalry, even though it is a competitive relationship, may provide this to a greater extent than anonymous competition. Lastly, rivalry may motivate by providing an omnipresent and challenging goal for performance (Locke, Shaw, Saari, & Latham, 1981), as rivals tend to be enduring and evenly matched with the focal actor (as discussed subsequently). Overall then, I predict that individuals will be more motivated, and exhibit greater effort-based performance, when competing against their rivals as compared to opponents with whom they lack such relationships. Further, this should occur independent of tangible stakes or dislike.

### Antecedents of Rivalry

If rivalry affects motivation and performance, it begs the question, what causes rivalry? Existing anecdotal evidence and research suggest three main relational factors that may lead individuals to place increased importance upon outperforming certain opponents. First, similarity, despite generally fostering attraction and cooperation, may cause increased subjective competitiveness between competitors (Garcia, Tor, & Gonzalez, 2006; Rijsman, 1974; Seta, 1982), by increasing social comparison and the self-relevance of competition (Festinger, 1954). Second, repeated competition may foster rivalry. Recent research suggests that a competitive interaction can foster feelings of competitiveness that endure beyond its conclusion (Johnson et al., 2006). Further, repeated exposure to a stimulus intensifies one's initial disposition to the stimulus (Brickman, Renfield, Crandall, & Harrison, 1972; Zajonc, 1968). Analogously, repeated competition against the same opponent may lead to greater and greater competitiveness. In support of this, research finds that repeated social comparison to a target makes that target increasingly likely to become a "routine standard" of comparison, with whom comparisons become more automatic and have a greater impact upon self-evaluations (Mussweiler & Rüter, 2003). Third, evenly matched contests may create rivalry.<sup>2</sup> Research suggests that narrowly decided competitions (close calls) promote greater counterfactual thinking, rumination, and emotional reactions (Kahneman & Miller, 1986; Medvec, Madey, & Gilovich, 1995; Medvec & Savitsky, 1997). Thus, these contests may live on in the minds of competitors, increasing feelings of rivalry. Additionally, past close contests may create expectations of future evenly matched competition, and motivation is generally highest under conditions of moderate difficulty (Brehm, Wright, Solomon, Silka, & Greenberg, 1983; Stanne et al., 1999).

Kilduff et al. (2010) found correlations between these three factors and rivalry among university basketball teams. However, the extent to which these results apply to individuals remains unstudied. A secondary goal of this research, therefore,

is to explore whether these relational variables also predict interindividual rivalry.

## Contributions

This research seeks to make several contributions. First, it extends research on rivalry by (1) exploring rivalry among individuals absent intergroup dynamics, (2) systematically investigating whether rivalry can benefit motivation and performance, (3) comparing rivalry to nonrival competition while controlling for objective stakes. In doing so, this work also provides first tests of whether competition is relationally and historically dependent. Second, this research informs the long-standing debate about how competition affects motivation and performance. Third, the empirics combine online experiments with a large-scale archival study to show consistent effects under conditions of experimental control and external validity.

## Studies 1a and 1b

Two complementary studies presented a first test of the motivational and performance consequences of rivalry and also assessed some of its relational antecedents. Both asked adults from the general population to recall either a rival or a nonrival competitor, to assess their relationship with that person along various dimensions, and to rate their motivation and performance. The studies differed in the prompts used to elicit these recalled competitors. Study 1a sought to maximize definitional validity, whereas Study 1b sought to minimize demand effects.

## Study 1a

### Procedure

A total of 147 Amazon MTurk participants (60.5% male,  $M = 31.0$  years old) were randomly assigned to one of the two conditions. Participants in the *rivalry* condition were asked to recall a personal rival based upon the conceptualization of rivalry:

Please think of someone that you have competed against who you consider(ed) to be a personal rival. By a personal rival, we mean someone against whom competitions are of greater importance or significance to you, due to the relationship or past history that you have with this person. Please briefly describe this personal rival and the things you have competed on.

Participants in the *nonrival competition* condition received the same instructions, except that they were asked to recall a competitor they did *not* consider to be a personal rival: “By not being a personal rival, we mean that either you had no prior relationship with this person or whatever relationship you did have did not increase the importance or significance of your competition/competitions against this person.” Following this, participants completed items related to the person they described and their competitions against that person.

## Manipulation Check

Participants in the rivalry condition reported stronger feelings of rivalry than participants in the nonrival competition condition (4 items; e.g., “I consider this person to be a personal rival,” and “Competitions against this person were more important to me because of the relationship that exists(ed) between us”;  $\alpha = .86$ ;  $M = 5.09$  vs.  $M = 2.69$ ,  $t(145) = 10.79$ ,  $p < .001$ ). Unless otherwise noted, all scales in Studies 1a and 1b were from 1 = *not at all* to 7 = *very much*.

## Antecedents of Rivalry

Participants in the rivalry condition reported greater similarity (4 items; e.g., “I share similar characteristics and attributes with this person”;  $\alpha = .73$ ;  $M = 5.22$  vs.  $M = 4.78$ ,  $t(145) = 2.18$ ,  $p = .03$ ), repeated competition (3 items; e.g., “How often did you compete against this person?”—*Only once, 2–4 times, 5–9 times, 10+ times, on a regular basis* (i.e., all the time);  $\alpha = .89$ ;  $M = .50$  vs.  $M = -.41$  (standardized),  $t(145) = 6.96$ ,  $p < .001$ ), and evenly matched prior contests with their opponents (2 items; e.g., “My competitions against this person have been closely decided (i.e., the margins of victory or defeat were small)”;  $\alpha = .64$ ;  $M = 5.23$  vs.  $M = 4.75$ ,  $t(145) = 2.05$ ,  $p = .04$ ), than participants in the nonrival competition condition. These factors also correlated with reported feelings of rivalry, similarity:  $r(147) = .28$ ,  $p < .001$ ; repeated competition:  $r(147) = .65$ ,  $p < .001$ ; evenly matched contests:  $r(147) = .24$ ,  $p < .001$  (see Table 1).

## Motivation and Performance

Participants who recalled a rival reported significantly higher motivation than participants who recalled a nonrival competitor (3 items; e.g., “I was motivated in my competitions against this person”;  $\alpha = .73$ ;  $M = 5.88$  vs.  $M = 5.36$ ,  $t(145) = 2.48$ ,  $p = .014$ ,  $d = .42$ ). They also reported experiencing a greater performance boost (2 items; e.g., “My performance increased when I competed against this person, as opposed to other people”;  $\alpha = .68$ ;  $M = 5.56$  vs.  $M = 4.85$ ,  $t(145) = 2.90$ ,  $p = .004$ ,  $d = .49$ ). Moderation tests indicated that these effects did not vary by gender.

I also looked to see whether these results were robust to various controls. Participants rated the “tangible stakes (e.g., money, career success, grades, athletic success, etc.)” (1 = *nothing tangible at stake* to 7 = *very high*) of their competition/competitions, their agreement with the statements “I succeeded in my competition/competitions against this person” and “I dislike this person,” and answered “To what extent do you consider this person to be a friend?” and “How well do you know this person?” (1 = *not at all* to 7 = *very well*). Table 2 displays the results of multiple regression analyses of motivation and performance boost with all controls included. Condition (0 = *nonrival competition*; 1 = *rivalry*) remained positive and significant for motivation,  $\beta = .29$ ,

**Table 1.** Study 1a: Descriptives and Bivariate Correlations.

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. Condition ( <i>rivalry</i> = 1; <i>nonrival competition</i> = 0)													
2. Felt rivalry	3.77	1.79	.67***										
3. Motivation	5.59	1.28	.20*	.27***									
4. Performance boost	5.17	1.52	.23**	.40***	.56***								
5. Similarity	4.98	1.25	.18*	.28***	.29***	.30***							
6. Repeated competition	0.00	1.00	.50***	.65***	.34***	.37***	.25**						
7. Evenly matched competition	4.97	1.43	.17*	.24**	.41***	.41***	.64***	.31***					
8. Tangible stakes	4.69	1.91	.06	.10	.17*	.07	.01	.11	-.01				
9. Success	5.19	1.80	.10	.07	.21*	.20*	.29***	.15	.27***	.21*			
10. Dislike	2.76	1.93	.25**	.26**	-.02	-.10	-.19*	.15	-.18*	.24**	-.01		
11. Friendship	4.02	2.25	.16*	.37***	-.07	.19*	.32***	.33***	.20*	-.07	.05	-.44***	
12. Knowing the person well	4.70	2.04	.43***	.60***	-.02	.20*	.25**	.49***	.11	.11	.16	-.05	.72***

\* $p \leq .05$ ; \*\* $p \leq .01$ ; \*\*\* $p \leq .001$ .

$t(140) = 3.14, p = .002$ , and perceived performance increase,  $\beta = .24, t(140) = 2.59, p = .011$ .

In addition, given that prior research has already linked similarity and motivation (e.g., Festinger, 1954; Rijsman, 1974; Seta, 1982), I ran models that also controlled for similarity to show that it does not account for rivalry's entire motivational and performance boosts. In a simultaneous regression of motivation, rivalry was significant,  $\beta = .25, t(139) = 2.72, p = .007$ , as was similarity,  $\beta = .27, t(139) = 3.13, p = .002$ . Similarly, rivalry,  $\beta = .21, t(139) = 2.25, p = .026$ , and similarity,  $\beta = .19, t(139) = 2.21, p = .028$ , both predicted performance.

## Study 1b

Study 1a provided initial evidence that rivals—competitors with whom we have relationships that heighten our perceived significance of competition—tend to be more similar and evenly matched to us and push us to perform better. Results for repeated competition and motivation were less conclusive, given that the manipulations made explicit reference to the existence or absence of a relationship that heightened the importance of competition, which may have created demand effects. The manipulations in Study 1b were designed to minimize demand effects and to provide a more direct test of whether repeated competition against an evenly matched opponent promotes greater motivation and performance. Additionally, I measured identity relevance of the competition domain as an additional control (e.g., Britt, 2005).

## Procedure

A total of 170 participants (59.4% male;  $M = 26.6$  years old) were recruited via Amazon MTurk. Participants in the *rivalry* condition were asked to:

Please think of someone that you have competed against who you consider(ed) to be a personal rival (for example, someone you have repeatedly competed against and/or have been evenly-matched

**Table 2.** Study 1a: Regression Analyses of Motivation and Performance Boost.

Variables	Motivation	Performance boost
Condition (0 = nonrival; 1 = rival)	.74** (.24)	.73* (.28)
Tangible stakes	.12* (.06)	.05 (.07)
Success	.12* (.06)	.13 (.07)
Dislike	-.12 (.07)	-.11 (.08)
Friendship	-.05 (.08)	.07 (.10)
Knowing the person well	-.08 (.09)	-.01 (.10)

Note.  $N = 146$ . Terms represent unstandardized coefficients (with standard errors in parentheses).

\* $p \leq .05$ , \*\* $p \leq .01$ , \*\*\* $p \leq .001$ .

with). Please briefly describe this personal rival and the things you have competed on.

Participants in the *nonrival competition* condition were asked to “Please think of someone that you have recently competed against.” Again, these manipulations attempted to minimize demand effects. In the rivalry condition, instead of defining rivalry or invoking increased importance of competition, I provided example antecedents of repeated and closely decided competition. I decided not to include similarity because its role in driving motivation is already established (Rijsman, 1974; Seta, 1982); repeated competition and evenly matched prior contests are more unique to rivalry. In the nonrival competition condition, instead of explicitly asking them to recall a nonrival, which might suggest expectations of lower motivation, I asked them to recall a recent competitor. A downside of this is that some participants might recall a personal rival; however, this would work against my hypothesis.

## Manipulation Check

Participants in the rivalry condition reported significantly greater rivalry than participants in the nonrival competition condition,  $M = 4.77$  vs.  $M = 4.02, t(168) = 3.24, p = .001$ .

**Table 3.** Study 1b: Descriptives and Bivariate Correlations.

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Condition (rivalry = 1; nonrival competition = 0)														
2. Felt rivalry	4.40	1.55	.24***											
3. Motivation	5.62	1.21	.18*	.36***										
4. Performance boost	5.14	1.45	.18*	.51***	.55***									
5. Similarity	4.54	1.28	.11	.33***	.30***	.38***								
6. Repeated competition	0.00	1.00	.19*	.62***	.19*	.23**	.36***							
7. Evenly matched competition	4.49	1.52	.17*	.46***	.36***	.49***	.72***	.44***						
8. Tangible stakes	4.18	1.86	.05	.20**	.08	.07	.07	.23**	.01					
9. Success	5.01	1.76	.04	.07	.14	.20**	.26***	.08	.22**	-.03				
10. Dislike	3.04	2.06	.09	.17*	-.08	-.14	-.31***	-.02	-.27***	.27***	-.17*			
11. Friendship	4.30	2.19	-.06	.14	.09	.25***	.46***	.19*	.43***	-.24**	.07	-.69***		
12. Knowing the person well	4.98	1.80	.14	.41***	.13	.17*	.47***	.37***	.41***	-.10	.09	-.35***	.72***	
13. Identity relevance of domain	4.66	1.36	.04	.45***	.23**	.35***	.15*	.27***	.19*	.43***	.06	.15	.00	.08

\* $p \leq .05$ ; \*\* $p \leq .01$ ; \*\*\* $p \leq .001$ .

**Table 4.** Study 1b: Regression Analyses of Motivation and Performance Boost.

Variables	Motivation	Performance boost
Condition (0 = nonrival; 1 = rival)	.39* (.19)	.60** (.20)
Tangible stakes	.00 (.06)	-.01 (.06)
Success	.07 (.05)	.14* (.06)
Dislike	-.07 (.07)	.03 (.07)
Friendship	-.02 (.08)	.26** (.09)
Knowing the person well	.04 (.08)	-.14 (.09)
Identity relevance of competition domain	.21** (.08)	.37*** (.08)

Note.  $N = 170$ . Terms represent unstandardized coefficients (with standard errors in parentheses).

\* $p \leq .05$ , \*\* $p \leq .01$ , \*\*\* $p \leq .001$ .

### Antecedents of Rivalry

Given that the manipulation of rivalry invoked repeated and evenly matched competition, these serve largely as additional manipulation checks. Participants in the rivalry condition reported competing more frequently with their opponents,  $M = .17$  vs.  $M = -.17$ ,  $t(168) = 2.49$ ,  $p = .01$ , and having been more evenly matched,  $M = 4.75$  vs.  $M = 4.24$ ,  $t(168) = 2.19$ ,  $p = .03$ , compared to participants in the nonrival competition condition. On similarity, participants in the rivalry condition scored nonsignificantly higher than participants in the nonrival competition condition,  $M = 4.68$  vs.  $M = 4.39$ ,  $t(168) = 1.44$ ,  $p = .15$ . Similarity,  $r(170) = .33$ ,  $p < .001$ , repeated competition,  $r(170) = .62$ ,  $p < .001$ , and evenly

matched prior competition,  $r(170) = .46$ ,  $p < .001$ , were again all positively associated with rivalry intensity (see Table 3).

### Motivation and Performance

Participants in the rivalry condition reported significantly higher motivation than participants in the nonrival competition condition,  $M = 5.84$  vs.  $M = 5.41$ ,  $t(168) = 2.30$ ,  $p = .023$ ,  $d = .36$ , as well as a significantly higher performance boost,  $M = 5.41$  vs.  $M = 4.89$ ,  $t(168) = 2.38$ ,  $p = .018$ ,  $d = .36$ . These effects did not vary by gender. Table 4 displays the results of multiple regression analyses with control variables, including identity relevance of the domain (2 items; e.g., “To what extent is the domain in which you competed personally important to you?”;  $\alpha = .71$ ). Condition continued to predict motivation,  $\beta = .23$ ,  $t(162) = 2.75$ ,  $p = .007$ , and performance boost,  $\beta = .21$ ,  $t(162) = 2.93$ ,  $p = .004$ .

### Study 2

Studies 1a and 1b provided initial evidence for positive links between rivalry and motivation and performance. Study 2 examined actual performance in long-distance running. Running is well suited for this research because (1) competition occurs frequently; (2) there is a fairly clear link between motivation and performance; (3) performance is largely independent, mitigating issues with studying the effects of rivalry on competitive performance in team sports (e.g., Kilduff et al., 2010); (4) online results provide data on performance and runners' histories of competition; (5) the majority of amateur races—including those studied here—do not offer substantial prizes for performance, reducing the plausibility of tangible stakes as an explanation for any findings.

**Table 5.** Study 2: Rivalry Formula 1.

Dimension	Formula
Similarity	$5 \times (\text{same gender}) + \text{MAX}((10 - \text{ABS}(\text{focal age} - \text{target age}))/2, 0)$
Repeated competition	$10 \times (\text{number of races run by both runners together}/\text{number of races run by the focal runner})$
Evenly matched contests	$\text{MAX}((30 - (\text{average margin of victory b/w runners}))/3, 0)$

### Pilot Test

I first surveyed 72 runners (34 female) from a northeast running club. In all, 56.9% indicated they felt rivalry toward at least one other runner in their region, which increased to 76.5% among those who had run at least five races in the previous year. Runners indicated having 2.92 rivals on average (standard deviation [*SD*] = 1.29). Of the 41 runners who indicated feeling rivalry, 37 completed an optional open-ended question, “Do you have any thoughts about how rivalry affects you?” These responses (e.g., “Rivalry gives me additional motivation to do my best”) were coded by two blind research assistants for mentions of “being more motivated in the race, pushing themselves more, running harder, trying harder, running faster, or performing better” ( $\alpha = .72$ ; differences were resolved through discussion). In all, 67.6% of runners reported a motivational and/or performance increase as a result of rivalry, which increased to 73.9% for those who had run at least five races during the prior year. Thus, runners reported that rivalry was common and positively affected motivation and performance.

### Main Study

In the main study, I analyzed actual race results. After identifying an appropriate region for study, I downloaded and formatted 6 years of online race results and identified a sample of regular runners. I then split the data into two. The first 3 years were used to empirically identify runners’ rivals, based upon the antecedents of rivalry. The ensuing 3 years were used to test whether runners ran faster in the presence of these rivals.

### Race Data

Results from 184 races (2004–2009) were collected from the website of a running club located in a midsized U.S. town. Each race file indicated its length, and the race time, gender, and age of all participants. Races ranged between 3.0 and 21.1 km (half marathon;  $M = 7.65$ ;  $SD = 4.51$ ). Across these 184 races, there were 34,905 runner races, for an average number of runners per race of 189.7 ( $SD = 249.9$ ; median = 91).

### Regular Runners

To ensure a baseline level of commitment, I iterated through all race files and identified runners who participated in at least

two races per year during 2004–2009 ( $N = 82$ ; 35.4% female;  $M = 44.2$  years old,  $SD = 8.94$  as of December 31, 2006;  $M = 28.2$  races run 2004–2009). This yielded a sample of 2,312 runner races, which was reduced to 2,279 after elimination of outliers (see online supplemental materials).

### Identifying Rivals

The 72 races from 2004 to 2006 (1,016 runner races) were used to empirically identify rivals, based upon the antecedents of rivalry. For all 82 regular runners, I computed scores (0–10) for similarity, repeated competition, and evenly matched head-to-head contests for each of the other 81 runners, as shown in Table 5. Thus, 6,642 pairs of runners were scored. For similarity, I awarded 5 points for same gender and up to 5 points for similar age, from 0 for differences 10 years or above, up to 5 for equivalent ages ( $M = 4.12$ ,  $SD = 3.04$ ). Ten years was used as the cutoff because race results often included a supplemental breakdown into age groupings of 10 years (e.g., 30–39), potentially providing an additional basis for social comparison and rivalry. For repeated competition, points were given equal to the proportion of the focal runner’s races that the target runner had also competed in, multiplied by 10 ( $M = 2.88$ ,  $SD = 2.27$ ). For evenly matched past contests, points were given based on the average margin of victory between the runners in their head-to-head contests (from 0 for average margins above 30 s/km, up to 10 for runners who ran equal times in their races together;  $M = 1.31$ ,  $SD = 2.47$ ). Note that this is not just a measure of similarity in ability, as it looks only at races in which runners ran head to head. These formulae were designed to be as face valid and simple as possible and to give roughly equal weighting to each of the three antecedents to rivalry. They were formulated prior to running any analyses of race performance.

The three measures were not substantially correlated with one another ( $r = .04$ – $.08$ ). I standardized scores on each dimension and assigned each runner pair a composite rivalry score. Finally, from these data, I identified the five opponents with highest rivalry scores for each runner (five was the maximum number of rivals reported in the pilot test).

### Analyses of Performance

Results from 112 races from 2007 to 2009 (1,263 runner races) were analyzed to test whether performance was greater in the presence of rivals. I created several measures of rivalry. The first was a dummy variable, set to 1 if at least one of the focal runner’s rivals was present at the race ( $M = .72$ ,  $SD = .45$ ). I also measured the total number of rivals present ( $M = 1.40$ ,  $SD = 1.25$ ), and the presence of the top-scoring rival ( $M = .32$ ,  $SD = .47$ ). Finally, I created a continuous measure that assessed the total “amount” of rivalry experienced by a focal runner in a given race, equal to the sum of the rivalry scores of all present rivals ( $M = 1.87$ ,  $SD = 1.78$ ).

To account for nesting of race times within runners, I used hierarchical linear modeling (HLM; Hofmann, 1997; Raudenbush, Bryk, & Congdon, 2008).<sup>3</sup> The

**Table 6.** Study 2: HLM Analyses of Race Performance.

Variables	Model 1	Model 2	Model 3	Model 4
Male	−53.34*** (10.40)	−53.34*** (10.40)	−53.34*** (10.40)	−53.34*** (10.40)
Age	2.41*** (0.56)	2.41*** (0.56)	2.41*** (0.56)	2.41*** (0.56)
Number of runners (log transformed)	2.15** (0.76)	2.62*** (0.81)	1.83* (0.76)	2.39** (0.80)
Rival present	−4.92*** (1.39)			
Number of rivals		−1.89*** (0.55)		
Top rival present			−2.83* (1.33)	
Total rivalry				−1.18** (0.41)

Note.  $N = 1,263$  runner races. All models include fixed effects for distances. Terms represent unstandardized coefficients (with standard errors in parentheses). \* $p \leq .05$ ; \*\* $p \leq .01$ ; \*\*\* $p \leq .001$ .

dependent variable was pace, in seconds/kilometer, run by the focal runner. Gender and age were controlled for at the runner level. At the race level, fixed effects were included for the 15 different race distances in the sample. These were used instead of a continuous distance variable because the latter would incorrectly assume a linear relationship between distance and pace. I also controlled for the number of runners in the race, log transformed, which assessed possible audience effects and served as a proxy for the “prominence” of the race. Thus, the models I estimated were as follows:

$$\begin{aligned} \text{LEVEL 1: Pace} &= \beta_0 + \beta_1(\text{Rivalry}) + \beta_1(\text{LOGNumRunners}) \\ &+ \beta_3(\text{DistDummy1}) + \beta_4(\text{DistDummy2}) \dots \\ &+ \beta_{16}(\text{DistDummy14}) + r. \end{aligned}$$

$$\begin{aligned} \text{LEVEL 2: } \beta_0 &= \gamma_{00} + \gamma_{01}(\text{Age}) + \gamma_{10}(\text{Male}) + u_0 \\ \beta_1 &= \gamma_{10} + u_1 \\ &\dots \\ \beta_{16} &= \gamma_{160} + u_{16}. \end{aligned}$$

As seen in Model 1 of Table 6, the presence of at least one rival predicted significantly faster race times,  $\gamma_{10} = -4.92$ ,  $t(1,165) = -3.54$ ,  $p < .001$ , by an estimated 4.92 s/km. Thus, in 5-km race, a runner would be expected to run roughly 25 s faster if at least one of his or her rivals was also in the race, as compared to if none of his or her rivals were present. Number of rivals present, Model 2;  $\gamma_{10} = -1.89$ ,  $t(1,165) = -3.43$ ,  $p < .001$ , presence of the top-rated rival, Model 3;  $\gamma_{10} = -2.83$ ,  $t(1,165) = -2.13$ ,  $p = .034$ , and the continuous measure of rivalry, Model 4:  $\gamma_{10} = -1.18$ ,  $t(1,165) = -2.91$ ,  $p = .004$ , also predicted increased performance. Moderation analyses indicated that these effects did not depend upon the gender of the runners, nor their relative ability levels.

To test the robustness of these findings, I reran all analyses—calculated rivalry scores for every runner pair, identified runners’ rivals, and analyzed race times—using revised formulae for the repeated and evenly matched competition components of rivalry (see Table 7). Rivalry continued to positively predict race performance; additional details and regression results are available in the online supplemental materials.

**Table 7.** Study 2: Rivalry Formula 2.

Dimension	Formula
Similarity	$5 \times (\text{same gender}) + \text{MAX}((10 - \text{ABS}(\text{focal age} - \text{target age}))/2, 0)$
Repeated competition	$(\ln(\text{number of races run by both runners together})/\ln(23)) \times 10$
Evenly matched Contests	$\text{MAX}((20 - (\text{average margin of victory b/w runners}))/2, 0)$

I also ran analyses controlling for similarity in demographics and average race times, to again show that rivalry is more than just similarity. I measured similarity for all pairs of regular runners by a composite of the demographic similarity measure previously employed and a measure of runners’ similarity in ability. This was equal to runners’ absolute difference in average running pace from 2004 to 2006, from 0 for runners’ whose paces differed by more than 30 s/km up to 10 for runners with equal pace. Thus, this captured similarity in performance across all races, whether or not both runners were present. I then standardized and averaged these two measures; across all 6,643 pairs of regular runners, similarity was correlated with rivalry at  $r = .50$ .

I then identified each runner’s Top 5 most similar opponents and ran a set of simultaneous HLM analyses of race performance that included measures of the presence of both similar and rival opponents. In all four models, rivalry remained significant, whether measured by the presence of a rival,  $\gamma_{10} = -4.08$ ,  $t(1,243) = -2.85$ ,  $p = .005$ , the number of rivals present,  $\gamma_{10} = -41.65$ ,  $t(1,243) = -2.75$ ,  $p = .006$ , the presence of the top-ranking rival,  $\gamma_{10} = -2.84$ ,  $t(1,243) = -2.11$ ,  $p = .035$ , or a continuous measure of the total amount of rivalry present,  $\gamma_{10} = -1.02$ ,  $t(1,243) = -2.27$ ,  $p = .023$ . Similarity predicted race performance when measured by the presence of at least one similar other,  $\gamma_{10} = -3.52$ ,  $t(1,243) = -2.54$ ,  $p = .012$ , but did not achieve significance for the other three measures ( $p$  values = .32, .75, and .31, respectively).

Finally, one possible alternative explanation for these findings is that the measure of rivalry could be capturing the presence of “running buddies,” or runners who run side by side—a more cooperative experience that might also boost performance. Two factors lend credence to the rivalry interpretation over this alternative explanation. First, the survey data I

collected are consistent with the rivalry story. Second, the median margin in finish times between pairs of runners identified as rivals was equal to 9.3 s/km (i.e., 46.5 s for a 5K; this dropped to 5.0 s/km for top rivals). This would seem close enough to incite rivalry—perhaps via examination of the final results as well as by visual identification while racing—but not so close as to suggest dyads literally running together.

## Discussion

A set of mixed-method studies provided evidence that the histories and relationships of competitors can affect their rivalries and, consequently, their motivation and performance in competition. This research makes several important contributions. First, it extends our understanding of rivalry. It represents the first real scientific evidence that rivalry can improve motivation and performance, the first comparison between rivalry and nonrival competition and the first investigation into rivalry among individuals.

Second, these studies are among the first to suggest that competition is history dependent—that is, that competitive behavior can vary based upon prior interactions between competitors. Interestingly, this suggests potential departures from rationality, at least as it is narrowly defined. Rationally, the frequency or outcomes of contests long since past would seem irrelevant to the significance of current competition; instead, factors such as tangible stakes and odds of victory should be paramount.

Third, these findings help inform the relationships between competition, motivation, and performance. As documented in a number of studies, competition imposed upon unacquainted individuals can hamper motivation (e.g., Deci et al., 1981). However, these findings suggest that competition between individuals with a history of competing may be beneficial.

## Future Directions

There are many potential future directions for this research. First, there may be some important downsides to rivalry. By motivating individuals independent of objective stakes, rivalry could foster a willingness to do “whatever it takes” to win, including risk taking and sacrificing one’s own gains to limit one’s rivals. Second, future research should explore the consequences of rivalry for performance on more complex or precision-based tasks, for which increased motivation may be less beneficial. Third, future work should dig deeper into the underlying psychology of rivalry and how exactly it motivates. The possibilities could include increasing social comparison concerns, providing a salient and omnipresent goal for performance, and increasing feelings of relatedness, meaning, or identity relevance.

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## Notes

1. <http://www.aolnews.com/2010/03/13/agassi-sampras-feud-publicly-at-charity-event>
2. Evenly matched past contests may correlate with similarity in ability; however, the two are conceptually distinct. For example, two tennis players may be similarly ranked but still experience lopsided matches in head-to-head meetings.
3. Hierarchical linear modeling (HLM) models reported employ group mean centering. Analyses were also run without centering and using grand mean centering, with no meaningful difference in results.

## Supplemental Materials

The online appendices are available at <http://spp.sagepub.com/supplemental>.

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### Author Biography

**Gavin J. Kilduff** is an assistant professor of management and organizations at the NYU Stern School of Business. He studies rivalry, competition, and status dynamics; e-mail: gkilduff@stern.nyu.edu.