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JEL Classification: J16, L83, M5

Keywords: peer effects, Gender, Competition, tournaments, experience, mixed-sex, single-sex, random assignment

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Gender Differences in Tournament Performance Over Time: Can Women Catch-Up with Men?

By Alison Booth, Ryohei Hayashi and Eiji Yamamura*

April, 2019

Abstract

We investigate the evolution over time of gender differences in single-sex and mixed-sex tournaments, using field data from the Japanese Speedboat Racing Association (JSRA). The JSRA randomly assigned individuals into single-sex and mixed-sex races, enabling us to model learning in different environments. Our dataset comprises over one million person-race observations of men and women making their speedboat racing debut between 1997 and 2012. We find that the average debut-woman's performance (measured by lane-changing and place-in-race) improves faster than debut-men's in single-sex races, but more slowly than debut-men's in mixed-sex races. For the average male racer, the opposite is true.

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I. Introduction

A number of studies, using both experimental data and data from the field, have found that females' competitive performance in tournaments is lower in mixed-sex environments than in single-sex.[1] While experimental economists are able to randomly assign subjects into treatments – single-sex or mixed-sex groups – and hence eliminate worries about selection, it is rare to find studies using *field* data that randomly allocate individuals into single-sex and mixed-sex environments. An exception is Booth and Yamamura (2018), who used field data from the Japanese Speedboat Racing Association to do exactly that. However, their study did not examine how gender differences evolve over the course of multiple interactions, nor were they able to look at racers' performance from their debut.

In the present paper we investigate how gender differences in aggressiveness (as proxied by lane-changing) and in performance (place-in-race) evolve in the process of skills accumulation. We do this by tracking the performance of the same individuals, from the time they made their debut into the speedboat racing profession and started competing with other racers in the mixed-sex and single-sex competitions to which they were randomly assigned. The randomization is key to enabling us to identify differences between male and female debut racers as they gain experience.

Our data come from the Japanese Speedboat Racing Association (JSRA). The beauty of these data is that the JSRA randomly assigns racers into two treatment groups: single-sex and mixed-sex races. Thus selection is not an issue when investigating the impact of single-sex or mixed-sex groups on performance. Moreover, the same-model boats used by racers are randomly assigned on race-day, as also are the motors. Motors and boats are randomized separately. Our estimating sample comprises over one million person-race observations of all men and women who made their racing debut in the observation window 1997 to 2011. The randomization enables us to establish some facts about male and female debut racers as they gain experience, and to shed light on learning in single-sex and mixed-sex environments. In particular, we find (controlling for ability

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[1] Studies investigating gender differences in performance in mixed-sex and single-sex environments include Gneezy, Niederle, and Rustichini (2003), Jackson (2012), Lee, Niederle, and Kang (2014), Booth, Cardona-Sosa, and Nolen (2018). Studies exploring gender differences in preferences to enter a competition include Booth and Nolen (2012), while studies analyzing attitudes toward risk include Booth, Cardona-Sosa, and Nolen (2014).

and a host of other controls) that the average debut woman's performance improves faster than debut men's in single-sex races, but more slowly than men's in mixed-sex races. For the average male racer, the opposite is true.

There are two related strands of the literature on gender differences in tournaments that are especially relevant to ours. First, there are those that investigate the impact of single-sex or mixed-sex environments on gender differences, typically in the context of experiments. Studies using experimental data to examine the impact of single-sex or mixed-sex environments on the competitive performance of men and women include Gneezy, Niederle, and Rustichini (2003) and Booth and Nolen (2012).

However, there are few field studies on competitive performance in which individuals have been randomly assigned into the two treatment types that are our focus of interest. Indeed, to our knowledge the only one with completely random assignment is that of Booth and Yamamura (2018). While the interesting paper by Backus et al. (2016) examines performance in chess tournaments in which players are randomly assigned, female players are allowed to select out of playing male opponents, which has the effect of introducing some non-randomness into their data.

The second strand of the literature on gender differences in tournaments that is especially relevant to ours focuses on two stage or multi-stage competitions in the field. In particular, several studies have used admissions competitions to selective educational programs to show how male and female respondents alter their performance in the second stage of a selection process as compared to the first. For example, Ors, Palomino, and Peyrache (2013) compares the performance of the same students in a less competitive high school national exam and subsequently in a very competitive exam for entry into a selective business school.[2] Cai et al. (2019) and Iriberri and Rey-Biel (2018) look at gender differences in performance in two stage competitions. Cai et al. (2019) use data from the college entrance exam (*Gaokao)* in China, the first stage of which is a mock examination.[3] Iriberri and Rey-Biel (2018) use data from a two-stage math competition

[2] Ors, Palomino, and Peyrache (2013) used French data to compare outcomes from the 'noncompetitive' national baccalaureate exams with the extremely competitive entrance exam for admission to the MSc in Management. They find that men perform better than women in the competitive admission contest, despite the fact that in the same cohort of candidates, women outperformed men in the national baccalaureate, and - amongst those who got in - outperformed men at the end of the first year of MSc.

[3] Cai et al. (2019) find that, compared to male students, females underperformed on the highly competitive

in Madrid in Spain.[4] These three studies all found that women perform worse in the second stage than the first.

In the present paper we investigate how differences in aggressiveness evolve in the process of skills accumulation. We do this by tracking the performance of the same individuals from the time they make their debut into the speedboat racing profession and compete in mixed-sex and single-sex competitions. This enables us to decompose gender differences in aggressiveness into innate characteristics and the outcome of accumulating skills. We find that women starting their racing careers are less aggressive than men. However, as they gain experience, the gender gap in aggressiveness disappears, because women's learning effect is larger than men's. So instead of becoming more psychologically stressed, as found in some other studies like the two-stage competitions mentioned above, the women in our study improve their performance and their ability to change lanes.

The remainder of the paper is set out as follows. In Section II we outline the institutional background of the Japanese Speedboat Racing Association. This is described in some detail, since this will assist the reader in understanding the empirical results. In Section III we provide an overview of the data and the descriptive statistics. In Section IV, we explain the estimation approach, while Sections V and VI present respectively the estimation results for two measures of performance – lane-changing and place-in-race. Section VII summarizes our conclusions and draws out some implications for future research.

II. Speedboat Racing in Japan: Data and Description

Our data are individual records for all racers who made their racing debut at some point within the period May 1997 - December 2012. These panel data were obtained from "Boat Advisor", the database of Japanese Speedboat Racing Association (JSRA). We chose this

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Chinese entrance exam - called *Gaokao* - relative to their performance in the low stakes mock examination. They attribute this to female's relatively lower tolerance for psychological pressure as well as their weaker incentives to perform in such a high-stakes situation.

[4] Iriberri and Rey-Biel (2018) analyse two-stage elimination math contests, in which participants compete to pass from stage 1 to stage 2 and later to be among the winners. They find that the gender gap in maths performance increases from stage 1 to stage 2. They attribute the increase in female underperformance to higher competitive pressure.

time period because we were able to obtain the full set of individual records starting in 1997, and the race rules were significantly altered in April 2012.[5] The engines or motors, owned by the JSRA not by racers, were randomly allocated to racers by a lot on race day.[6] The boats were randomly assigned separately to the random assignment of the engines. Races at all 24 boat-race stadia in Japan are included in our dataset.

Our data comprise the 120 females and 750 males who made their racing debut this period. Our estimating sample comprises all those races with complete information about racers' records, which yields approximately 1,300,000 person-race observations. This is a far larger sample than those used to study gender differences in competition based on experiments (e.g., Dreber, von Essen, and Ranehill 2011; 2014; Cárdenas et al. 2012) and utilizing survey data (e.g., Buser, Niederle, and Oosterbeek 2014; Almenberg and Dreber 2015; Backus et al. 2016).

In our dataset, we have a rich set of variables, including racer's performance measured by lane-changing behaviour and place-in-race, as well as detailed information about the characteristics of the race.[7] These include place and day of the week, grade of race, gender composition of the race, and the condition of racers (as captured by their weight on race day), and the like. We also obtained information about competitors who were not making their debut, in order to control for the characteristics of each debut racer's competitors that are likely affect their performance (such as the ability and weight of competitors within a given race). For example, we are able to control for the number of higher ability racers against which a debut racer is competing, which likely affects the debut's performance.

Speedboat racing in Japan takes the form of tightly-controlled tournaments arranged by the Japanese Speedboat Racing Association (JSRA). Male and female professional speedboat racers receive exactly the same training at a single school, the

[5] Before 2012, racers could use their own propellers that they attached, on race-day, to the engine, and which they could adjust to their race style and strategy.

[6] Before the rule-change about propellers in 2012, racer's strategy and style varied considerably, and men were markedly more aggressive than women. Figure A1 in the appendix compares 'aggressiveness' over the period 1996 to 2015, and shows that, after the 2012 rule change, women racers became more aggressive.

[7] In Booth and Yamamura (2018) we used individual records for the period April 2014-October 2015. In that paper we were able to use data only from seven (representative) stadia, as the information about race-times – the focus of that paper – was unavailable for the other stadia. In the present paper, we focus on place-in-race, available for all 24 stadia, as well as lane-changing.

Yamato Kyotei Gakko (Yamato Boat School).[8] Entry to this school is highly competitive, and is restricted to individuals aged between 15 and 29 years.[9] Successful entrants are required to train for one year and to pass a final examination.[10]

Once trained, men and women participate and compete with each other in the races under the same conditions. Each race has six participants. Racers are randomly assigned to mixed-sex or single-sex races by the JSRA well before a race-day. Moreover, on race-day, boats and motors are randomly assigned to racers for that day (apart from propellers in our sample period, as discussed above). For all races, boats and motors are the same model and make, and are used for only one year. However, individual performance may vary across boats and motors due to differences in deterioration and maintenance. To avoid unfairness across racers, allocation of machines is decided by drawing lots.[11]

In Booth and Yamamura (2018) we described in considerable detail the institutional features of speedboat racing in Japan. This information was mainly obtained from Himura (2015). Though the observation window of the current paper is earlier than in the Booth and Yamamura (2018) paper, the principal institutional features remain.

There are twenty-four speedboat racing stadia throughout Japan and boat races are randomly held about four days per week in each stadium. Racers go to many different stadia to compete. The racing circuit is a large artificial pond or sectioned-off body of water that is 600 metres in length. Competitors race around it three times, leading to a total race-distance of 1,800 metres. In each racing fixture, there are twelve races, and six racers compete in any given race. The prizes offered are considerable.

Speedboat racing uses the 'premature start' system, in which boats must pass the

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[8] The Boat School moved from Yamanashi to the Fukuoka prefecture in 2002. The former school name was Motosu Knshujo (Hase 2011, 140–41).

[9] Because of this wide age-window, entrants are from a variety of backgrounds, ranging from recent college-leavers from junior high school right up to university graduates with a subsequent career. Therefore, time since graduation from the Boat School is not just picking up age.

[10] According to (Hase 2011, 139), there were 1,350 applicants for the 2010 entrance exam to the Yamato Boat School. Of these, only 38 were admitted and 31 graduated (27 men and 4 women). During the studied period, the passing rate of the exam did not change. Training covers driving techniques and inspection and maintenance of the engine and boat.

[11] On race-meeting day and before each race, each contestant performs a solo exhibition run of 150 metres along a straight section of the circuit. Since racers are obliged to inspect and maintain mechanically (without assistance) the boat and engine allocated to them, they use these publicly observable performance times to obtain information not only about competitors' condition, but also about their own. This information is also useful to the betting fraternity.

starting line within a second after the starting clock reaches zero. This is illustrated in Appendix Figure 2. Standby warm-up refers to the period from the time racers receive the signal to leave the docks (pit) to the moment they cross the starting line. Racers' initial pits - and therefore lanes - are determined prior to the race by the committee of the association. However, racers can strategically change their lane during the initial period of turn-round, and may thus end up in a different position for the start of the race. Following in a position behind another boat is judged as a violation.

A. Racers and Gender

Japanese speedboat racing is characterized by an openness to age and gender. As noted above, the JSRA randomly assigns racers to single-sex and mixed sex races. For women, the difference between the women-only race and mixed-sex race is that all 5 competitors are the same-sex (female) in the women race. Reflecting the gender ratio, there are only one or two women racers among six racers in most cases of mixed-sex races. Thus, the composition of mixed-sex races differs considerably for men and women, since men always outnumber women in the mixed races.

Rules and condition are equivalent among different types of races. Therefore, even in the mixed-sex races, women racers are treated on an equal basis as men. Consequently there is no difference in prize money between genders in the mixed-sex races or in the all-male and all-female races. The only exception to equal treatment is with regard to the minimum weight: men have to weigh more than 50 kg while women have to be over 47.5 kg.

[Insert Figures 1(a), 1(b) and 1(c) near here]

Next, we consider the number of racers. Figure 1(a) shows that, in 1997, the number of racers was just over 1,700, and it declined to 1,560 in 2011. During this period, racer's ages varied between approximately 18 and 65 years.[12] Figure 1(b) shows the number of debut racers over the period in which we are interested. The number of male debut racers was far larger than that of females, although this difference decreased

[12] The youngest permissible age of a racer is 16 years and there is no compulsory retirement age.

because debuts of men racers declined. Figure 1(c) reveals the increasing proportion of women racers.[13]

B. *Race Grade, Racer's Grade, Prize, and Penalty.*

Race participants win prize money depending on whether they come first, second, or third in each race. In addition, all racers receive a show-up fee for participating on race-day even if they are not placed. The order in which participants cross the finishing line is denoted as their place in that race. Races are also classified into five grades: Super Grade (SG), Grade I (GI), Grade II (GII), Grade III (GIII), and 'Usual' races. In higher-grade races, winners can earn more points, as we describe below, and following Himura (2015, 67–74). Grades of races are characterized by the following. Any racers can participate in the Usual race, which is the bottom rank. In GIII races, racers under 30 years old with high winning rates are selected to participate. The criteria for being selected to participate in GII and GI races are stricter. In SG, racers are selected from top-ranked racers on the basis of prior performance. Within a year, the number of races is 8 in the SG; around 40 in the GI; 8 in the GII; around 50 in the GIII; and almost every day for the Usual races.

Prize money for race-winners is considerable, for first place being around US$400,000 (SG), US$70,000 (GI), US$40,000 (GII), US$10,000 (GIII) and under US$6,000 (Usual races) over the studied period.[14] Women racers did not run SG races during the studied period and most women racers participated most frequently in Usual races. There are also other monetary prizes. Taking Usual races as an example, prize winnings are around US$ 4,000 (second place), US$3,000 (third), US$2,500 (fourth), US$2,400 (the fifth), under US$100 (the sixth) (Fujino 2006, 108).[15]

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[13] According to (Hase 2011, 35), in the 1950s and 1960s, women racers were rare and unpopular, leading the authority to reduce women racers to 4. However, after 1966 when the boat school was established, the number of women racers increased and so too did their skills at competing with men racers. In 1983, the single-sex women's race was held for the first time for 23 years. In 1985, women racers reached nearly 100 and same-sex women's races could be held in various stadia, so that women races became integrated into racing (Ueshima 1986, 123). Further, in 1985, 7 women racers earned over US$ 100,000 (Ueshima 1986, 212).

[14] From 2012, the first-place prize money changed from US$400,000 (SG) to US$300,000, and US$70,000 (GI) to US$100,000 (Fujino 2006; Hase 2011). However, the prize money did not change for GII, GIII and Usual races.

[15] In the studied period, there were no available data on average annual earnings of racers in each grade. However, we obtained other information about racers' earnings from a variety of sources, as noted in text and footnotes.

The JSRA selects race-participants. Various status racers, from the top to the bottom levels, are evenly and randomly assigned to participate in the Usual races. As a result, top-class racers participate not only in the high-grade races such as SG and GI but also in the Usual races.

As noted above, a racer obtains points according to his or her order in the race.[16] Penalties are also possible: for instance, if participants navigate poorly and break rules in the race, or in the turnaround period, lose 7 points. Individuals' aggregated points in a season are subsequently used to select participants into the top-grade (SG) race. Racers disqualified for interrupting other racers are automatically excluded from SG races. There is an extra element to points-accumulation: each individual's points are aggregated for three years and the total then determines *racers' grades*, known as A1, A2, B1, and B2. (We shall use this as a measure of ability.) Participants disqualified for interrupting others during a race lose 15 points from their aggregated three-year score. If they break the rules – either for the actual race or in the turnaround period – they lose 2 points. Hence racers have a considerable incentive not only to win the race but also to avoid rule breaking and potentially losing their grade-classification.

For the time period 1997 to 2012, data were unavailable for the average annual earnings of racers in each grade. However, to give an idea of earnings, we note that in 2006, Yutaka Imamura, the top racer of A1, got the highest life time earnings, US$ 22,000,000 (Fujino 2006, 110).[17]

Higher grade racers are allowed to participate in more races. Even on a day when there are no high-grade races, A1 racers can take part in the Usual race and so can earn something. Furthermore, higher grade racers can also participate in higher-grade races with greater rewards. Women compete in fewer races than men. Inevitably, composition of ranks of racers for women is lower than for men.

[16] For example, in the bottom-grade race (Usual race) and the next-to-bottom race (GIII), points accumulated in first, second, third, fourth, fifth and sixth places are 10, 8, 6, 4, 2, and 1 points, respectively (Himura 2015). In the case of GI and GII (SG), one point (two points) is (are) added to each of the points listed above. Participants navigating poorly or breaking rules lose 7 points.

[17] Imamura was born in 1961 and made a spectacular debut in the boat race by attaining the first place in 1981 when he was just 20 years old. For the years between 20 and 45 years old, he averaged about US$ 1,000,000 per year. His annual earnings were almost equal to that of star players in Japan Professional Football league in this period. For instance, Kenta Hasegawa, who was a regular member of the football team representing Japan in 1990s, earned US$ 1,000,000 in 1995 (Nikkan-Sports 1996).

Racing in an inner lane confers an advantage. Racers are permitted to change lane but if they interrupt other racers' runs, they are disqualified and face severe penalties. Consequently, racers changing to an inner lane need to be highly skilled in order to avoid interrupting others. In cases of disqualification, racers are penalized not only by losing points but also by being prohibited from racing for one month and banned from participating in GI and SG races for a year. This is costly, since disqualification reduces both aggregated points and the likelihood of shifting to a higher grade with its greater earning potential. Top-class racers are those who can change to a better lane while avoiding disqualification.

C. Strategies

Racing a speedboat against others involves skill not only at maneuvering the boat but also at jockeying for a desirable position, since the inner lanes confer an advantage. Contestants can choose ways of boosting their own performance as well as adversely affecting the performance of their immediate competitors. These activities involve costs, and contestants therefore face simple trade-offs when making decisions. By increasing performance-enhancing activities like effort, a racer increases her probability of winning but this extra effort is costly. The expected gain from winning is greater the bigger the prize-spread, and hence the more worthwhile it will be to boost own-performance.

Own-performance can be improved not only by effort in the actual race, but also through fine-tuning the engine of the randomly allocated boat, and dieting to achieve optimal weight. Strategies that adversely affect competitors' performance include seizing command of an inner lane as well as subtly intimidating competitors. Lane-changing is easily observable, subtle intimidation is not. And yet it is a potent – if unobservable - way of weakening opponents' concentration.

While lane-changing can bring benefits, it can also bring costs, since breaking the strict rules leads to serious penalties. Owing to male characteristics of 'over-confidence' or a greater tendency to take risk (as found for example in Dreber, von Essen, and Ranehill 2014; Almenberg and Dreber 2015), male speedboat racers may be more likely than women to adopt an aggressive strategy. Moreover, they might be more likely to be successful at it, if women are less confident in mixed-races. Within our dataset, aggressiveness is proxied by lane-changing. Our prediction is that women racers follow a less aggressive or confident strategy than men and are less successful at lane-changing. Whether this confidence is innate, or can be developed over time, is something that we aim to establish with our data.[18]

III. Overview of the Data and Descriptive Statistics

Figure 2(a) gives the average number of races in which racers participated, and it illustrates that women compete in fewer races than men. Inevitably, composition of ranks of racers for women is lower than for men.

[Insert Figures 2(a) and 2(b) near here]

Figure 2(b) plots changes of assigned lane in the turnaround period of a race in relation to performance as measured by place in race, which runs from first to sixth place. Figure 2(b) reveals that those who changed initial lane down towards the first lane performed better, being on average third placed. The average place for those changing up to a worse lane was just under fourth.

Figure 3 plots racers' aggressiveness – proxied by lanes changed – against number of race-participations. Figure 3(a) demonstrates changes in racers' aggressiveness from their debut to their 2,000th race, while Figure 3(b) presents changes in debut racers' aggressiveness for their first 500 races. We describe these as the full sample and the subsample respectively. One reason for having these two samples is that racers who run 2000 races may be a more selected bunch than those running 500, if the less skilled and less aggressive racers drop out. Note that the number of races in which an individual participated is a proxy for experience rather than the passage of time. This is because race participation varies considerably even across racers making their debut in the same year.

[Insert Figures 3(a) and 3(b) near here]

In Figures 3(a) and (b), the vertical axis displays mean values of "aggressiveness" calculated separately for male and female debut racers. If a racer does not change lane,

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[18] Unfortunately, we do not have information on the number of attempted infractions relative to the number a person is actually charged with. Thus, we cannot test the hypothesis – even if women racers are found to be less aggressive –that they are less/more likely to be penalized than men in the mixed-sex race.

the value is 0. If a racer changed up towards the sixth lane, it is a negative value and the racer is less aggressive, while if the racer changed up towards the first lane, it is positive and the racer is more aggressive. To take an example, if a racer changed from the first lane to the third, the value is -2. The figure shows that racers learn from their experiences and accumulate lane-changing skills as they participate in more races. Figure 3(a) demonstrates that both male and female racers had negative values of around -2 directly after their debut and hence they were less aggressive than more experienced racers. Then, as they participate in more races, the values converge to 0 at around 500 races. On closer examination, we see that women's average value is lower than men's directly after their debut. This means that women start off less aggressive than men. However, as women gain experience, the gender gap disappears, and subsequently women overtake men because their learning effect is larger than that of men. For closer examination, Figure 3(b) – which looks only at the first 500 races – tells us that women's lane-changing performance overtook men's after they ran 300 races.

[Insert Figures 4(a) and 4(b) near here]

Next we turn to Figures 4(a) and (b), which show changes in place-in-race. This measure of performance in a race ranges from 1 to 6, and larger values show a higher performance. Consistent with our finding for lane-changing, we find that women's placement in races is lower than men's immediately after their debut. However, women learn to improve their performance. Because their learning effect is larger than that of men, the difference between men and women disappears after women racers run 1500 races. Note that, as illustrated in Figure 4(b), the gap in race performance persists for longer than the gap in aggressiveness that we described above in relation to Figure 3(a).

[Insert Table 1 near here]

Descriptions of key variables are provided in Table 1 for the full sample (2,000 races since debut) and for the subsample (500 races since debut). Our dependent variables (shown in the top panel) are lane-changing and place-in-race. Average race-participation is 1,122 for the full sample and 240 for the subsample (see bottom panel, first row). The various indicators for lane-changing show that more racers change to a better lane in the full sample than in the subsample. This indicates the improvement in racing skills that comes with experience. Place-in-race ranges from first to sixth, and for the larger sample, the average place in race is better than for the subsample. This is as expected, since racers have less experience in the subsample.

'*Motor's* winning rate' gives information about engine performance, where the winning rate is defined as the percentage of races in which the randomly assigned motor attained first or second place in previous races. It is interesting to observe that the *motor's* winning rate for the full-sample is around 33%, which is almost the same as that for the sub-sample. This reflects the random assignment of motors to racers, which logically leads to a winning rate of 33.

On the other hand, a *racer's* winning rate gives information about racer's performance, where the winning rate is defined as the percentage of races in which the racer attained first or second place in previous races. A *racer's* winning rate is 32% for the full sample and 18% for the sub-sample. Clearly racers who have not been participating for long – only 500 races as given in the last column - do worse, and there is scope for their skills to be improved. Note that the *racer's* winning rate is defined over the previous half year, and hence alters as each individual participates in more races. This is the first of our three variables measuring racing ability.

Our second proxy for ability is the 'number of racers with a higher winning rate'. This captures the racer's previous half-yearly performance relative to that of competitors in any given race at time *t*. Our third ability proxy is the 'number of higher-grade racers', which indicates, for any given race, the number of racers of a higher grade (as defined in detail in Section II.B) than a particular racer. Its maximum is 5 and its minimum is 0. We also include the weight of competitors, since heavier racers run more slowly. Definitions of the other control variables are provided in the table and are self-explanatory.

IV. The Econometric Model

Our randomization is key to enabling us to document some basic stylized facts about male and female debut racers as they gain experience. In particular, we will find that the average debut woman's performance improved faster than debut men's in single-sex races, but more slowly than men's in mixed-sex races. For the average male racer, the opposite is true.

To establish these results, we estimated the following specification for our outcome measures:

$$R_{itk} = \alpha_0 + \alpha_1 M_{itk} + X_{it}'B + e_i + m_{tk} + u_{itk}, \qquad (1)$$

The dependent variable R denotes the performance of individual i on race-day t at stadium k. These performance measures include lane-changing (our proxy for aggressiveness) and place-in-race. The constant is denoted by α_0 , while α_1 is the marginal effect of the treatment variables, M. Other controls are captured by the row vector $\boldsymbol{X}_{it}$, while B is the column vector of coefficients to be estimated. On a race meeting day, there are 12 races in a stadium. Superior-graded racers tend to participate in the 10^{th} to 12^{th} races among them even if there are only Usual races in the day. The conditions of races and racers vary according to place and day, because of weather and the random allocation of engine and boat. To control for conditions, we include dummies for place and days of the race and their interactions, as represented in (1) by m_{tk}. (We list other controls in the notes under the tables of estimates.) Unobservable individual time-invariant characteristics, e_i are controlled for through fixed-effects estimation. That is, we can divide factors to improve performance into nature, captured by e_i, and the learning effect captured by experience.

V. The Results: Lane-changing

Tables 2 to 4 present fixed effects estimates of lane changing, in which the dependent variable is lane-changing in the turnaround period, our proxy for aggressiveness. The regressions include controls for ability and the like, as shown in the notes under the tables. Debut racers initially assigned to the first and 6^{th} lanes are excluded because they are less likely to change lane (the results do not alter if these lanes are included). In general, the more races debut racers contest, the more lanes they change (conditioning on lane they are starting from when they leave the pit). Note that lane changes range from -4 to 4 , and that the larger is the number in absolute terms, the more lanes have been changed. For all tables of estimates, we report in parentheses robust standard errors clustered on racers.

First, consider the results in Table 2(a), estimated over the full sample of 2000 races for each debut racer. Our principal interest is in how debut racers learn from experience, measured by the number of races in which they have participated from their debut, and how this varies across treatments (single-sex and mixed-sex races). A priori, we expect performance to be increasing with participation.

[Insert Tables 2(a) and 2(b) near here]

The first three columns of Table 2(a) present the results for women. Column (1) gives the estimates for all women (74,495 person-race observations), while columns (2) and (3) give the estimates for, respectively, women in same-sex races (50,173 observations) and mixed-sex races (24,332 observations).[19] The estimates show that, ceteris paribus, women's changing to a better lane is indeed increasing with the number of races in which they participate. Looking across columns for women, the estimates clearly show that the average woman's debut performance improves faster in single-sex races than in mixed-sex races. When racing in women-only events, female racers show a significant improvement in lane-changing performance after their debut. For a woman who has contested 1,000 races, the lane improvement in a *single-sex race* from debut is large, at 3.7 lanes (6.9 x 0.53=3.66).[20] However, her lane improvement in a *mixed-sex* race after contesting 1,000 races is 1.66 lanes (6.9 x 0.24=1.66). At 500 races, the average woman in a single-sex race has improved lanes by 3.29 since her debut, while in a mixed-sex race she has achieved 1.49 lanes improvement since debut.

To see how these results for women compare with male lane-changing, we next consider the estimates for men given in the last three columns of Table 2(a). Here we see that male changing to a better lane is also increasing with the number of races in which they participate. Looking across columns for men, we note that there is a different pattern for debut male racers in the single-sex and mixed-sex races. In particular, the average debut man's performance improves faster in mixed-sex races than in single-sex races – the opposite to the result found for women. As an example, consider 500 races. Here the

[19] In the mixed-sex races in Column (3) of Table 2, the mean number of male competitors is 4.24. In the mixed-sex races in Column (6), the mean number of female competitors is 1.32.

[20] We know that *ln*(1000) = 6.9. Multiplying this by the estimated single-sex coefficient of 0.53 in column (2), gives 3.66. For a racer starting out, who has only one event, *ln*(1)=0. Thus experience of 1,000 race events gives an improvement since debut of 3.66 lanes for women in single-sex races. For 2,000 races, the lane improvement from 1,000 to 2,000 races, calculated the same way, is (7.6-6.9)x0.53=0.37. That is, most of the lane improvement for women competing in up to 2000 races is in the first 1000 races.

average man in a single-sex race has improved lanes by 2.24 since his debut, while in a mixed-sex race he has achieved 2.92 lanes improvement since debut.

Why might this be the case? One candidate explanation is that women are by nature less competitive than men and this explains our findings. However, this conjecture is one that we can immediately rule out. Here we find that debut women's lane-changing capabilities are significantly improved with race participation, and more so than are men's. Even when women race in a mixed-sex environment, their lane-changing ability is improved. In other words, they *learn* this skill, and therefore their improved performance cannot be due to nature alone. This result also shows that female competitive performance - even for women who have chosen a competitive career and are very good at it - is enhanced by being in a single-sex environment rather than in a mixed-sex environment in which they are a minority.

In Table 2(b), we report report fixed-effects estimates for the same samples as in Table 2(a), but we redefine the dependent variable as a dummy taking the values (-1, 0 or 1), depending on whether the racer changes to a better lane than the one to which s/he is initially assigned (1), to a worse lane (-1), or has no lane change (0). Again, we exclude racers starting in lanes 1 and 6 (our results are unchanged if we include those observations). The magnitude of the estimated coefficients is smaller, as we would expect from this form of the LPM in which we have combined subcategories of changers. However, we find the same broad results as in Table 2(a). The average debut woman's performance improves faster than debut men's in single-sex races, but more slowly than men's in mixed-sex races. For the average male racer, the opposite is true.

[Insert Table 3 near here]

In Table 3 we report the results of specifications in which we interact *ln*(participations) with the female dummy variable. This interaction term is statistically significant across all columns. The interaction term is positively signed in the single-sex race estimates of columns (2) and (5), and is negatively signed in the mixed-sex race estimates in columns (3) and (6). Further, it is interesting that the absolute value of the coefficients is approximately 0.10 in columns (2) and (3). That is, in the single-sex races, experience leads women racers to be more aggressive than men, whereas it leads women to be less aggressive than men in the mixed-sex races. In other words, due to accumulation of racing experience, both men and women become more aggressive although there is difference in its effect between sexes and across race type (single-sex or mixed-sex).

[Insert Tables 4(a) and 4(b) near here]

Next, we consider the results reported in Table 4(a), which reports fixed-effects estimates of the same specification as in Table 2(a), but estimated over the subsample of 500 races for each debut racer. The reader will recall that our reason for re-estimating this subsample is that the full-sample might suffer from selection issues: the less able may have dropped out, leaving a select bunch remaining for 2000 races. Table 4(b) reports the results of the same specifications as in Tables 2 and 3, but estimated over the subsample of 500 rather than the full sample. The results are consistent with the results shown above.

It is interesting to compare our *single-sex* estimates of the lane improvement of a woman in the subsample of 500 races with that of a woman in the sample of 2000 races. The woman from the larger sample has a lane improvement from debut of 3.29 lanes, while from the smaller sample she has a lane improvement of 2.24 lanes, suggesting some selectivity in the sample of stayers.

VI. The Results: Place in Race

Tables 5 to 7 present fixed-effects estimates of place in the race, which runs from first to sixth place. The regressions include controls for ability and the like, as shown in the tables and the notes under the tables. For all tables of estimates, we report in parentheses robust standard errors clustered on racers. In brackets in each table, we provide means for the outcome variable for the relevant control group.

[Insert Tables 5(a) and 5(b) near here]

To begin, consider Table 5(a), reporting estimates of place-in-race for the sample of 2,000 races. The first row of the table shows that women are better placed – that is more likely to win – the more races they have run. Considering our treatment variables – whether the women were in a single-sex or mixed-sex race – we find that women are better placed in single-sex than in mixed-sex races. Moreover, this effect is increasing with participation. From Column (2) we see that a woman who has run 2,000 races will be placed almost two places better in a single-sex race than a woman who is running her debut race. Analogously, a woman who has run 500 races will be placed 1.6 places better in a single-sex race than a woman who is running her debut race. From Column (3), we see that the woman in a mixed-sex race who has contested 2,000 races will be placed just over one place better than a woman making her first racing appearance. If she has contested 500 races, she will be placed 0.87 places better than a comparable woman at her debut. In sum, most of the improvement is in the first 500 races, and the improvement for women is more marked in the single-sex races.

For men, on the other hand, there are no differences across treatment types in the impact of the number of race participations for the full sample. Moreover, male participation always has a positive effect on place-in-race that is substantially smaller than the positive effect for women in the single-sex races. For the mixed sex races, the difference in impact of participation across gender is quite small.

Now we turn to estimates of place-in-race for the subsample, reported in Table 5(b).[21] This smaller subsample comprises racers who run 500 times during the period we are investigating. Again, we are interested in this group because the racers who go on to run 2000 may be a selected group of stayers. We therefore wished to compare estimates across the sample of up to 2000 races with the subsample of 500 races. We find the following from Table 5(b): for a woman who has contested 500 races, the place improvement in a single-sex race from debut is around 1.9 places.[22] However, after 500 races, the place improvement for such a woman in a mixed-sex race is just under one place (6.2 x 0.14=0.87). These results are very similar to the estimates we obtained for the larger sample of 2,000 races.

[Insert Table 6 near here]

[21] The sample size of column (1) of Table 5(b) is 25,538, which is a little smaller than 26,092 (Table 4(a)). During the race, some racers relinquished the race or were disqualified, leading to reduction of sample in Table 5.

[22] Multiplying $ln(500) = 6.2$ by the estimated single-sex coefficient of 0.30 in column (2) of Table 5(b) gives 1.86. For a racer starting out, who has participated in only one event, $ln(1)=0$. Thus experience of 500 race events gives a *ceteris paribus* improvement since debut of 1.86 places for women in single-sex races.

Table 6 reports fixed effects estimates of place in the race in regressions where we pool male and female observations, and interact the female dummy variable with the natural log of participations. The sample is again for the first 2000 races. The total number of person-race observations is well over a million. (More precisely, it is 1,288,648.) Here we see that being well-placed in the race is increasing with participations (the coefficient is 0.16) and that for female racers it increases by (0.16+0.07=0.23). However, in mixed-sex races there is a small negative effect to the interaction term for women.

[Insert Table 7 near here]

Table 7 estimates the same specifications albeit for a smaller subsample, being racers who ran 500 times during the period we are investigating. Note that the interaction term is not statistically significant in Column (1) of Table 7, which is consistent with Figure 2(a). However, once we divide the sample into same-sex and mixed-sex races, the interaction term is positive for the same-sex races (see Column (2)) and negative for the mixed-sex races (see Column (3)). The difference in magnitude between our coefficients of interest in Tables 6 and 7 reflects the fact that the improvements in race-place occur early on. This is consistent with Figures 4(a) and (b). However, from Tables 6 and 7 and Figures 4(a) and (b), we can see that the reduction in the gender performance gap in race-place occurred after experiencing 500 races. Therefore, compared with skill formation of lane-changing, more racing experience is required to reduce the gender gap in racers' performance. Nonetheless the gender performance gap persists for far longer in mixed-sex races than mixed-sex ones.

VII. Conclusion

In this paper we investigated how differences in aggressiveness (as proxied by lane-changing) and in place-in-race evolved in the process of skills accumulation. We did this by tracking the performance of the same individuals, from the time they made their debut into the speedboat racing profession and started competing with other racers in the mixed-sex and single-sex competitions to which they were randomly assigned. The randomization was key to enabling us to identify differences between male and female debut racers as they gain experience.

In our analysis, we decomposed gender differences in performance into innate characteristics (such as relative ability and the like) and the outcome of accumulating skills, controlling for other factors. We found that, upon debut, women are initially less aggressive than men. However, as they gain racing experience, the gender gap in aggressiveness disappears, because women's learning effect is larger than men's. Thus, ultimately the difference in aggressiveness between men and women disappears over time. However, the impact of experience on our second performance measure, place-in-race, was slower to take effect. Compared with lane-changing, more racing experience is required to reduce the gender gap in racers' performance measured by place-in-race. Moreover, the gender performance gap persists for far longer in mixed-sex races than mixed-sex ones.

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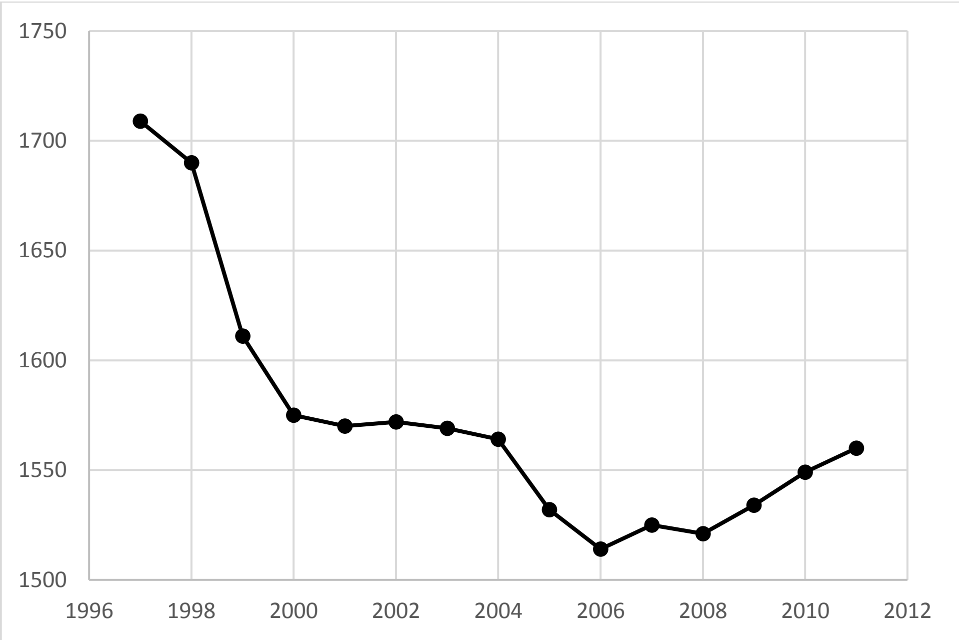

Figure 1(a). Number of racers.

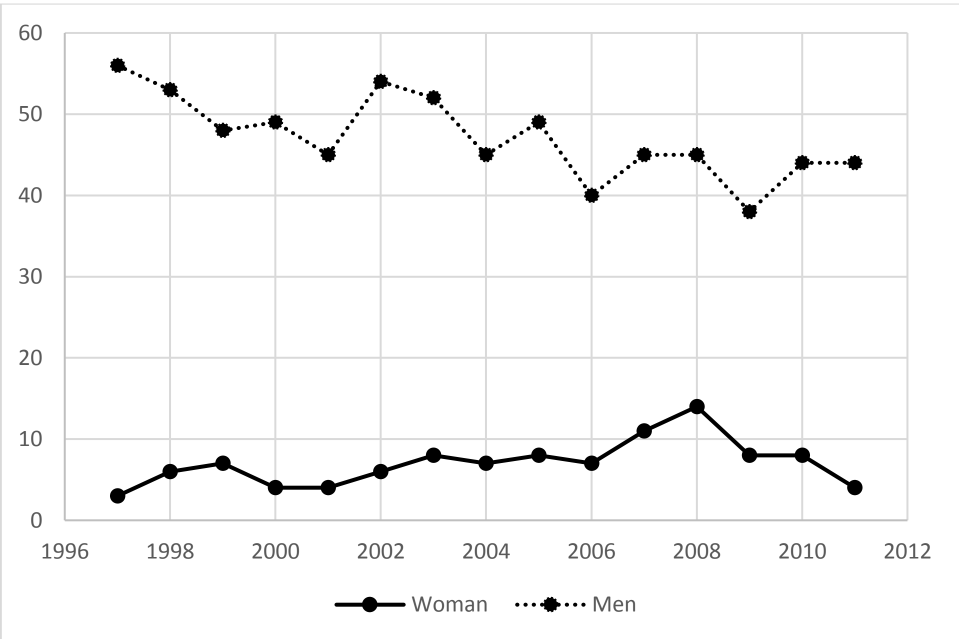

Figure 1(b). Number of debut racers.

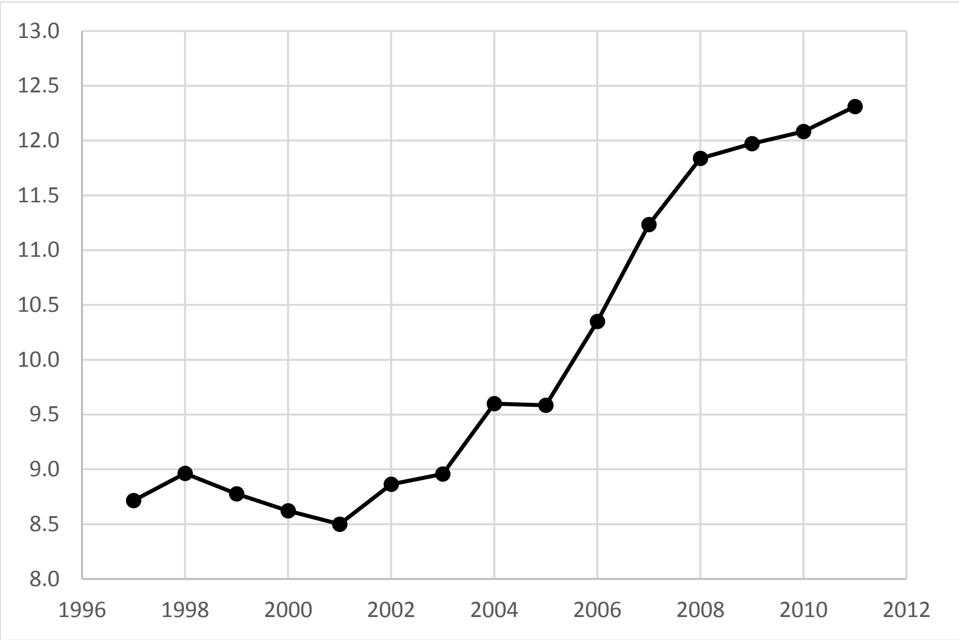

Figure 1(c). Rate of women racers over all racers (%).

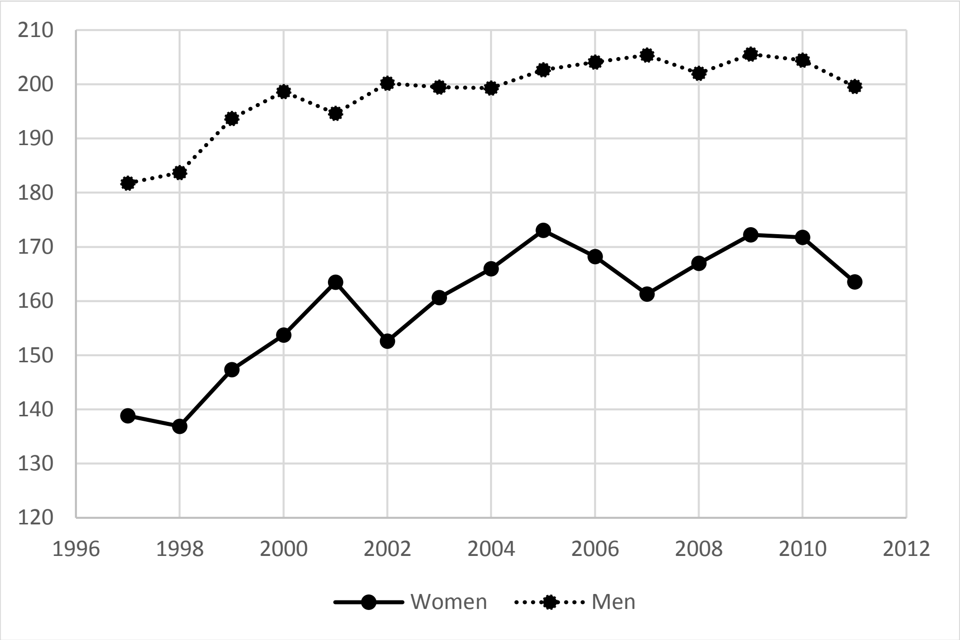

Figure 2(a). Average number of races where racers run.

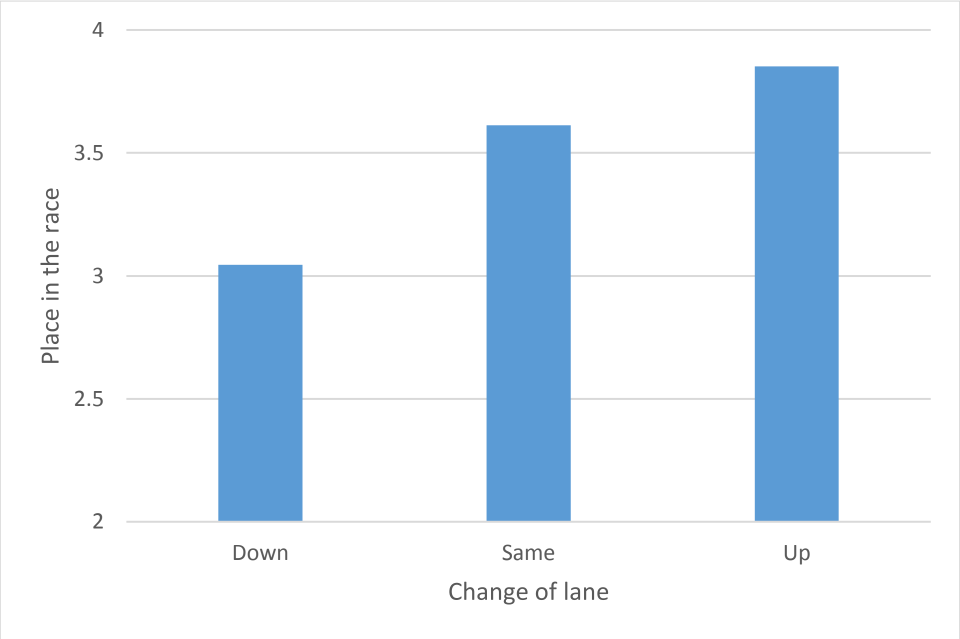

Figure 2(b). Lane changed and performance.

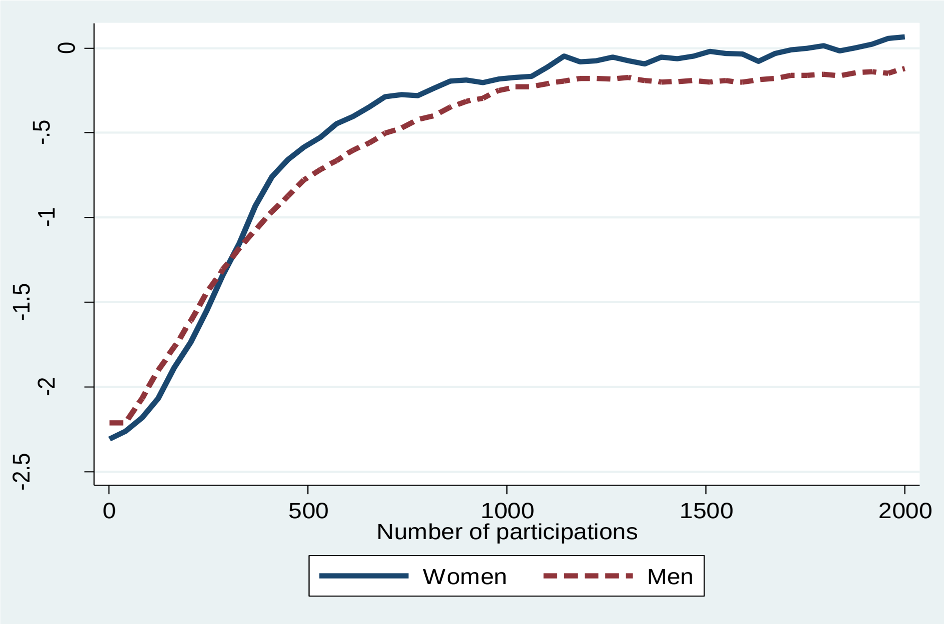

Figure 3(a). Smoothing of lanes changed and total number of participations in race since debut.

Note: Number of races: 0-2,000. (excluding 1 and 6 lanes racers)

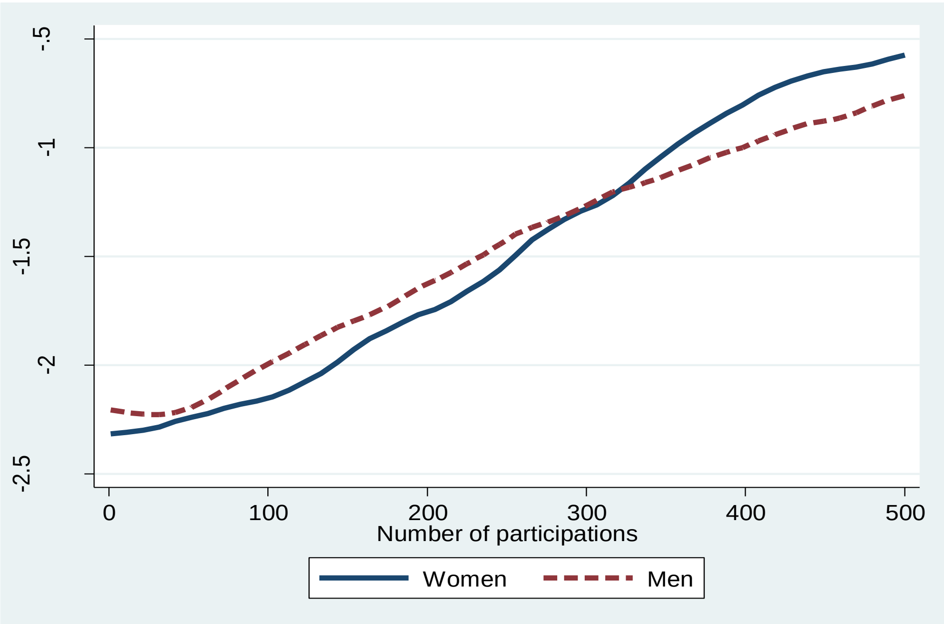

Figure 3(b). Smoothing of lanes changed and total number of participations in race since debut.

Note: Number of races: 0-500. Sample limited to racers who run more than 500 times to control for selection effect during the studied period. (excluding 1 and 6 lanes racers)

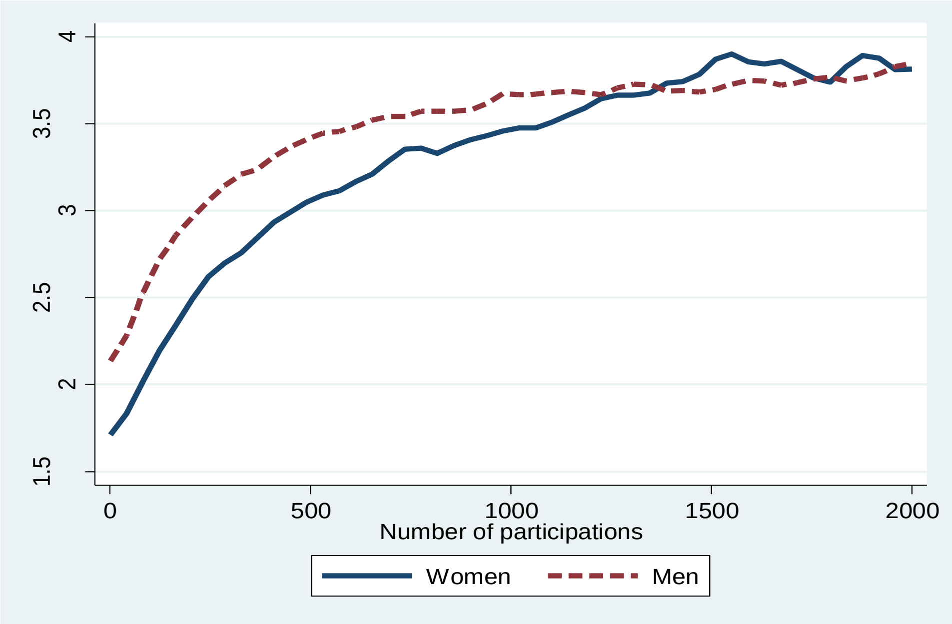

Figure 4(a). Smoothing of Racer's Performance (inverted value of place in the race) and total number of participations in race since debut.

Note: Number of races: 0-2000. (sample including 1-6 lanes racers)

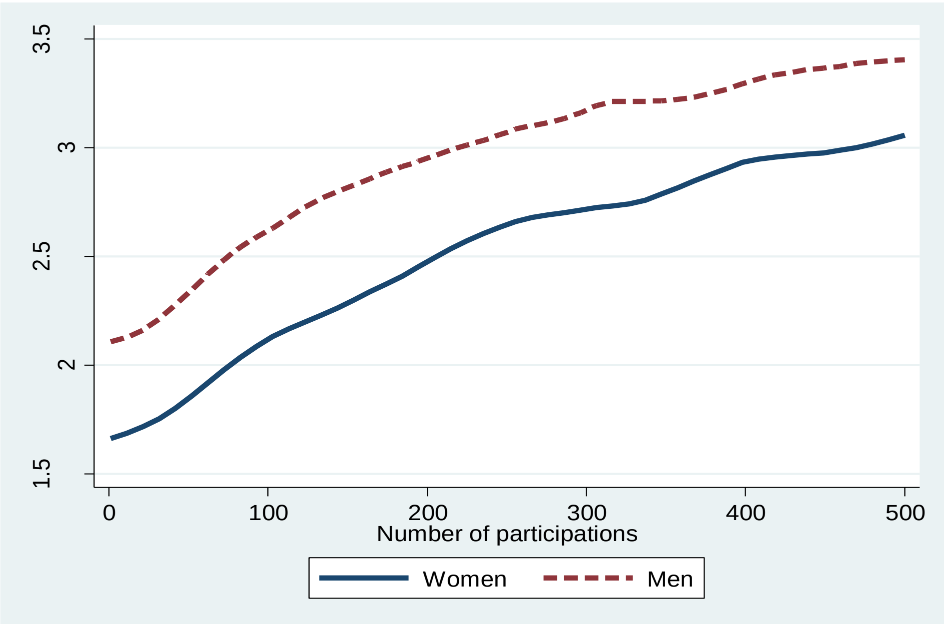

Figure 4(b). Smoothing of Racer's Performance (inverted value of place in the race) and total number of participations in race since debut.

Note: Number of races: 0-500. Sample limited to racers who run more than 500 times during the studied period. (sample including 1-6 lanes racers)

Table 1. Definition of variables

Variables	Definition	Whole sample	Subsample
Dependent variables			
Number of lanes changed	(positive if towards first lane, negative if towards sixth lane)	−0.47	−1.34
Down towards the first lane	Number of lanes changed down towards the first lane	0.17	0.09
Up toward the sixth lane	Number of lanes changed up toward the sixth lane	0.64	1.43
Lane changed	It takes 1, if lane changed down towards the first lane. It takes 0, if lane did not change. It takes – 1, if lane changed up towards the sixth lane.	−0.19	−0.51
Dummy for down	It takes 1 if lane changed down towards the first lane, otherwise 0.	0.12	0.07
Dummy for up	It takes 1 if lane changed up towards the sixth lane, otherwise 0.	0.32	0.58
Performance	Racer's performance:((Inverted value of place in the race)	3.47	2.93
Independent variables			
Participations	Total number of participation in races from one's debut.	1122	240
Place in the race	The higher place takes larger value. 1(the bottom) – 6 (Top)	3.47	2.85
Motor's winning rate	Percentage of motor attaining the first or second place in races.	32.4	32.1
Winning rate	Percentage of racers attaining the first or second place in races.	31.7	18.0
Number of higher class racers	Number of competitors with higher class (ranges from 0 to 5)	1.82	3.1
Number of racers with higher winning rate	Place of racer's winning rate among 6 racers in the previous season. 1 – 5	2.69	3.8
Number of racers with longer career	Place of experience as the racer among 6 racers. 1 – 5	3.98	4.62
Number of racers with heavier weight	Place of racer's weight among 6 racers. 1 – 5	2.21	2.35
Number of racers with motor of higher winning rate	Place of motor's performance assigned to the racer among 6 racers. 1 – 5	2.39	2.37

Note: Full sample comprises racers who run up to 2000 races; subsample comprises racers running up to 500 races.

Table 2(a). Full Sample FE Estimates of Lane-Changes in Turnaround Period (Lanes 1 and 6 excluded)

	Woman			Man		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Same-sex race	Mixed-sex race	All	Same-sex race	Mixed-sex race
Ln(Participations)	0.36***	0.53***	0.24***	0.36***	0.36***	0.47***
	(0.02)	(0.02)	(0.02)	(0.006)	(0.006)	(0.01)
Motor's winning rate	0.0008*	0.0006	0.0007	0.001***	0.001***	0.0004
	(0.0004)	(0.0006)	(0.0008)	(0.0001)	(0.0001)	(0.0004)
Winning rate	0.005**	−0.0002	0.01***	0.004***	0.004***	0.004***
	(0.002)	(0.002)	(0.002)	(0.0005)	(0.0005)	(0.0007)
Number of higher class racers	−0.06***	−0.09***	−0.04***	−0.09***	−0.04***	−0.03***
	(0.007)	(0.008)	(0.01)	(0.002)	(0.002)	(0.004)
Number of racers with higher winning rate	−0.07***	−0.07***	−0.08***	−0.09***	−0.09***	−0.08***
	(0.006)	(0.007)	(0.008)	(0.002)	(0.002)	(0.004)
Number of racers with longer career	−0.25***	−0.22***	−0.26***	−0.19***	−0.19***	−0.14***
	(0.01)	(0.01)	(0.02)	(0.002)	(0.002)	(0.005)
Number of racers with heavier weight	0.05***	0.05***	0.04***	0.02***	0.02***	0.03***
	(0.006)	(0.008)	(0.009)	(0.002)	(0.002)	(0.004)
Number of racers with motor of higher winning rate	0.002	0.006	−0.006	−0.006***	−0.006***	−0.08***
	(0.003)	(0.004)	(0.005)	(0.001)	(0.001)	(0.006)
Number of opposite sex racers	-0.09***		-0.07***	0.03***		0.08***
	(0.005)		(0.01)	(0.003)		(0.006)

Within R-square	0.48	0.45	0.48	0.38	0.39	0.30
Number of groups	116	112	116	756	756	692
Observations	74,495	50,173	24,322	806,615	724,148	78,467

Note: Numbers in parentheses are robust standard errors clustered at racer. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively. Numbers without parentheses are coefficient of each variable. Various control variables such as weather, wind-speed, scale of wave, lane dummies, racer's weight, racer's grade, dummies for stadia are included, but its results are not reported.

Table 2(b). Full Sample FE Estimates of Lane-changes (-1, 0 or 1) in Turnaround Period

(Lanes 1 and 6 excluded)

	Woman			Man		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Same-sex race	Mixed-sex race	All	Same-sex race	Mixed-sex race
Ln(Participations)	0.12***	0.20***	0.08***	0.14***	0.14***	0.19***
	(0.01)	(0.01)	(0.005)	(0.003)	(0.003)	(0.006)
Within R-square	0.35	0.33	0.28	0.24	0.25	0.20
Number of groups	116	112	116	756	756	692
Observations	74,495	50,173	24,322	806,615	724,148	78,467

Note: Numbers in parentheses are robust standard errors clustered at racer. *** indicates significance at the 1% level. Numbers without parentheses are coefficient of each variable. Various control variables such as weather, wind-speed, scale of wave, lane dummies, racer’s weight, racer’s grade, dummies for stadia are included, but its results are not reported.

Table 3. Full Sample FE Estimates Lane-changes in Turnaround Period (excluding 1 and 6 lanes racers)

	Number of lanes changed (−5 to 5)			Lane changed (−1, 0, 1)		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Same-sex race	Mixed-sex race	All	Same-sex race	Mixed-sex race
Ln(Participations)	0.36***	0.36***	0.42***	0.14***	0.14***	0.17***
	(0.006)	(0.006)	(0.01)	(0.003)	(0.03)	(0.005)
*Female dummy**	0.04***	0.11***	−0.10***	0.01**	0.06***	−0.07***
Ln(Participations)	(0.01)	(0.02)	(0.01)	(0.005)	(0.007)	(0.006)
Control group for Female dummy	[−0.57]	[−0.59]	[−0.45]	[−0.29]	[−0.30]	[−0.23]
Within R-square	0.39	0.39	0.35	0.25	0.25	0.21
Number of groups	872	868	808	872	868	808
Observations	877,110	774,321	102,789	877,110	774,321	102,789

Note: Numbers in parentheses are robust standard errors clustered at racer. Values within brackets are mean values of the base group (control group) for dummy variables. *** indicates significance at the 1% level. Numbers without parentheses are coefficient of each variable. All control variables in Table 2 are included, but its results are not reported.

Table 4(a). Subsample: FE Estimates Lane-changes in Turnaround Period (excluding 1 and 6 lanes racers)

	Woman			Man		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Same-sex race	Mixed-sex race	All	Same-sex race	Mixed-sex race
Ln(Participations)	0.16***	0.36***	0.09***	0.18***	0.18***	0.37***
	(0.02)	(0.03)	(0.02)	(0.01)	(0.01)	(0.03)
Within R-square	0.61	0.61	0.64	0.54	0.54	0.47
Number of groups	79	79	79	599	599	593
Observations	26,092	16,086	10,006	197,531	182,984	14,547

Note: Numbers in parentheses are robust standard errors clustered at racer. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively. Numbers without parentheses are coefficient of each variable. Various control variables such as weather, wind-speed, scale of wave, lane dummies, racer's weight, racer's grade, dummies for stadia are included, but its results are not reported.

Table 4(b). Subsample: FE Estimates Lane-changes in Turnaround Period (excluding 1 and 6 lanes racers)

	Number of lanes changed (−4 to 4)			Lane changed (−1, 0, 1)		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Same-sex race	Mixed-sex race	All	Same-sex race	Mixed-sex race
Ln(Participations)	0.18***	0.18***	0.27***	0.05***	0.05***	0.08***
	(0.008)	(0.008)	(0.03)	(0.003)	(0.003)	(0.01)
*Female dummy**	0.06***	0.24***	−0.14***	0.04***	0.13***	−0.05***
Ln(Participations)	(0.02)	(0.03)	(0.03)	(0.008)	(0.01)	(0.01)
Control group for Female dummy	[−1.48]	[−1.49]	[−1.29]	[−0.67]	[−0.68]	[−0.60]
Within R-square	0.55	0.55	0.54	0.29	0.29	0.26
Number of groups	678	678	672	678	678	672
Observations	223,623	199,070	24,553	223,623	199,070	24,553

Note: Numbers in parentheses are robust standard errors clustered at racer. Values within brackets are mean values of the base group (control group) for dummy variables. *** indicates significance at the 1% level. Numbers without parentheses are coefficient of each variable. All control variables in Table 2 are included, but its results are not reported.

Table 5(a). Full Sample FE Estimates of Racer's performance (inverted value of place in the race)

	Woman			Man		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Same-sex race	Mixed-sex race	All	Same-sex race	Mixed-sex race
Ln(Participations)	0.17***	0.26***	0.14***	0.16***	0.16***	0.16***
	(0.01)	(0.02)	(0.01)	(0.005)	(0.005)	(0.01)
Within R-square	0.18	0.17	0.14	0.30	0.31	0.22
Number of groups	116	115	116	756	756	692
Observations	110,011	73,983	36,028	1,178,637	1,063,475	115,162

Note: Numbers in parentheses are robust standard errors clustered at racer. *** indicates significance at the 1% levels. Numbers without parentheses are coefficient of each variable. All control variables in Table 2 are included, but its results are not reported.

Table 5(b). Subsample: FE Estimates of Racer's Performance (inverted value of place in the race)

	Woman			Man		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Same-sex race	Mixed-sex race	All	Same-sex race	Mixed-sex race
Ln(Participations)	0.18***	0.30***	0.14***	0.25***	0.25***	0.29***
	(0.02)	(0.03)	(0.02)	(0.01)	(0.01)	(0.04)
Within R-square	0.15	0.15	0.12	0.11	0.11	0.11
Number of groups	79	79	79	599	599	593
Observations	25,538	15,743	9,795	191,852	177,695	14,157

Note: Numbers in parentheses are robust standard errors clustered at racer. *** indicates significance at the 1% levels. Numbers without parentheses are coefficient of each variable. All control variables in Table 2 are included, but its results are not reported.

Table 6. Full Sample: FE Estimates of Performance (inverted value of place in the race)

	Man+ Woman		
	(1)	(2)	(3)
	All	Same-sex race	Mixed-sex race
Ln(Participations)	0.16***	0.16***	0.17***
	(0.005)	(0.01)	(0.01)
*Female dummy**	0.07***	0.14***	−0.04***
Ln(Participations)	(0.01)	(0.01)	(0.01)
Control group for Female dummy	[3.51]	[3.48]	[3.74]
Within R-square	0.14	0.14	0.12
Number of groups	872	871	808
Observations	1,288,648	1,137,458	151,190

Note: Numbers in parentheses are robust standard errors clustered at racer. Values within brackets are mean values of the base group (control group) for dummy variables. *** indicates significance at the 1% level. Numbers without parentheses are coefficient of each variable. All control variables in Table 2 are included, but its results are not reported.

Table 7. Subsample: FE Estimates of Racer's performance (inverted value of place in the race)

	Man+ Woman		
	(1)	(2)	(3)
	All	Same-sex race	Mixed-sex race
Ln(Participations)	0.25***	0.25***	0.24***
	(0.006)	(0.006)	(0.04)
*Female dummy**	0.01	0.11***	−0.08** (0.03)
Ln(Participations)	(0.01)	(0.02)	
Control group for Female dummy	[2.98]	[2.96]	[3.31]
Within R-square	0.11	0.11	0.10
Number of groups	678	678	672
Observations	217,694	193,712	23,982

Note: Numbers in parentheses are robust standard errors clustered at racer. Values within brackets are mean values of the base group (control group) for dummy variables. ** and *** indicate significance at the 5% and 1% levels, respectively. Numbers without parentheses are coefficient of each variable. All control variables in Table 2 are included, but its results are not reported.

Appendix.

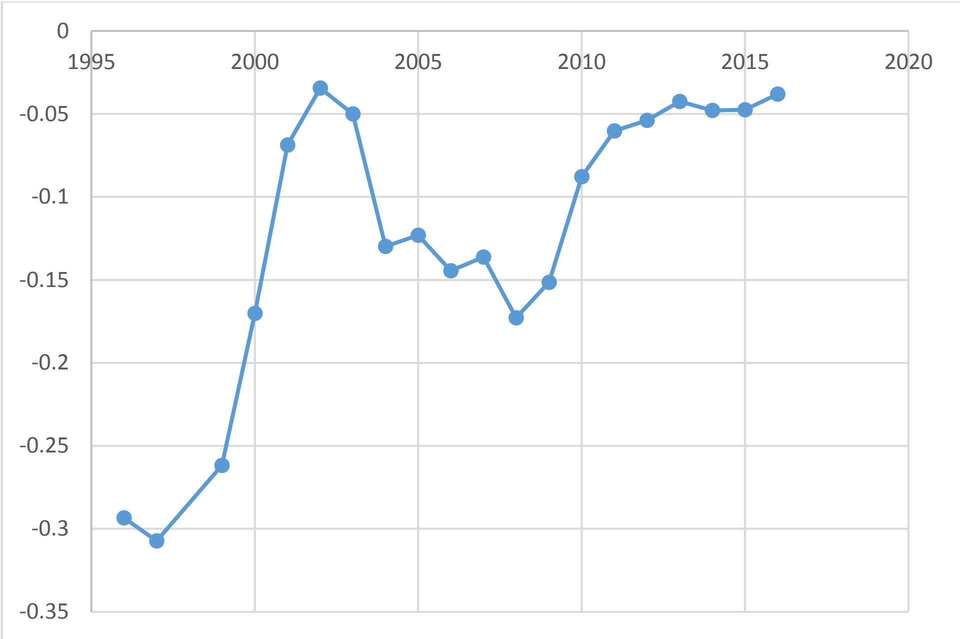

Figure A1. Average "Aggressiveness" of women racers over the period 1996-2016

Note: Sample of all women racers which included those who have debut before 1996.

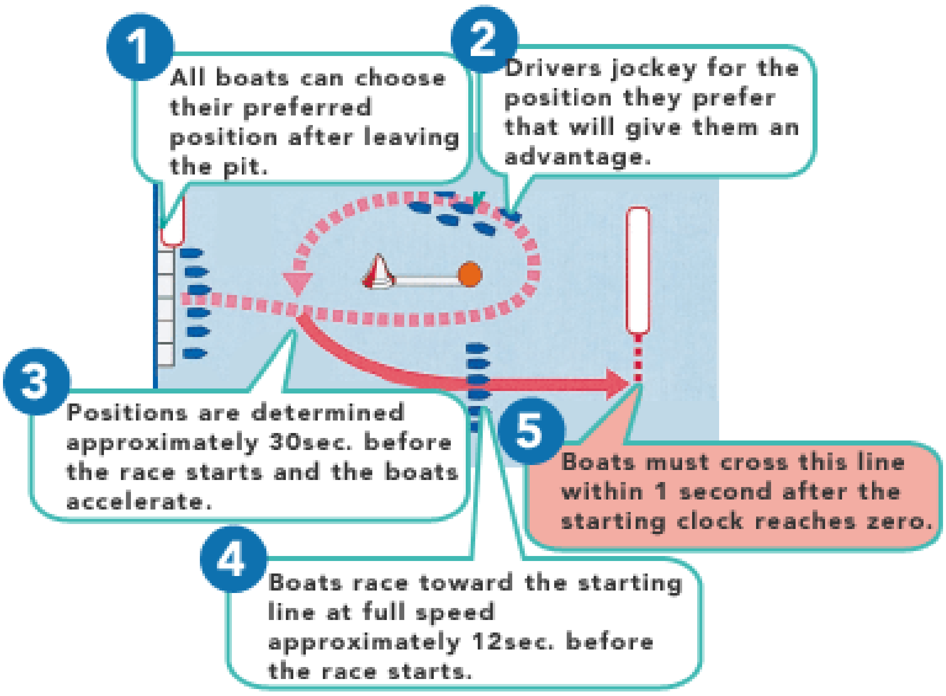

Figure A2. Premature Start System

Source: Website of Japan Boat Race Association

http://www.boatrace.jp/en.html (access on October 7, 2016)