An Investigation of Inconsistent Expectations of Horse Racing Experts by Analyzing Horses Classified into Three Sire Line Types

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***Abstract*—In recent years, statistical researches often showed even experts can make mistakes although they have a wealth of knowledge and experience. In this study, we focus on horse racing experts, such as racing horse owners and trainers, and investigate whether they have inconsistent expectations on their professional issue. Using sire line, distance of races, and order of finish as clues, we analyze the 36922 horses registered with Japan Racing Association from 2010 to 2017 statistically. The results of the statistical analysis showed that horse racing experts had inconsistent expectations on the problem of which race distance they thought were favorable for horses of a certain sire line. We think this is because many horse racing experts did not consider sire lines when deciding whether to continue to enter their horses in another race of a similar distance as they do when selecting race distance.**

Keywords-decision making; expert; Thoroughbred horse; sire line; race distance.

I. INTRODUCTION

Unlike most of us, experts have a wealth of knowledge and experience. However, even experts can sometimes make mistakes. For example, in the past, baseball coaches often taught players to aim for grounders rather than fly balls. However, in recent years, statistical researches brought a new batting approach that batters should aim for big fly balls rather than grounders. The new approach, known as the "fly-ball revolution", has surprised many baseball coaches and players around the world. The reason they were surprised is because they had a firm expectation on this issue and it was incorrect. The point is that they had one expectation on one issue. A question now arises whether experts have inconsistent expectations on one issue. In this study, we focus on horse racing experts, such as racing horse owners and trainers. In order to win horse races and get the prize money, they want to find races where their horses are more likely to win.

In order to analyze horse racing experts' inconsistent expectations, we focus on sire line, distance of races, and order of finish. A sire line is a term that refers to the paternal lineage or ancestry of a horse, especially a racehorse. Many people, especially horse racing experts, often say that a sire line can indicate the potential abilities or characteristics of a horse, such as which distance races they are good at. We analyzed horses classified into one sire line type and reported that horse racing experts had inconsistent expectations on the problem of which race distance they thought were favorable for horses of the sire line type [1]. In this study, we analyze horses classified into three sire line types and discuss whether horse racing experts had inconsistent expectations on the problem of which race distance they thought were favorable for horses of these three sire line types.

The rest of this paper is organized as follows: In Section II, we survey the related works. In Section III, we survey information about racehorses and show how to collect it. In Section IV, we show how to analyze racehorse information statistically and discuss whether horse racing experts have inconsistent expectations on their professional issue. Finally, in Section V, we present our conclusions.

II. RELATED WORK

Thoroughbred horses originated from a small number of Arab, Barb, and Turk stallions and native British mares approximately 300 years ago [2]–[4]. Since then, they have been selectively bred to improve speed and stamina, and are consequently superior competitive racehorses. Wade et al. reported a high-quality draft sequence of the genome of the horse and suggested that the horse was domesticated from a relatively large number of females, but few males [5]. McGivney et al. reported that centuries of selection for favourable athletic traits among Thoroughbreds acts on genes with functions in behavior, musculoskeletal conformation, and metabolism [6]. Recently, some genomic regions were identified as a candidate region influencing racing performance in racehorses [7]. Many researchers applied statistical models to evaluate various parameters on racing performance in Thoroughbred horses [8]. Martin, Strand and Kearney reported that the most influential parameter was distance raced [9]. Cheetham et al. investigated whether both race earnings and number of race starts were associated with horse signalment (age, sex, and breed), gait, and race surface [10]. Wells, Randle and Williams investigated how temporal, behavior, and loading related factors associated with the period before the start of the race influences racehorse performance [11]. Statistical researches are conducted not only in horse racing but also in other sports, such as baseball. In recent years, statistical researches brought a new batting approach that batters should aim for big fly balls rather than grounders [12]. Kato and Yanai reported that Shohei Otani, the Japanese superstar slugger in Major League Baseball (MLB), always aims for hitting fly balls [13]. This new batting approach, the so-called "fly-ball revolution", shows that even experts may make mistakes. It

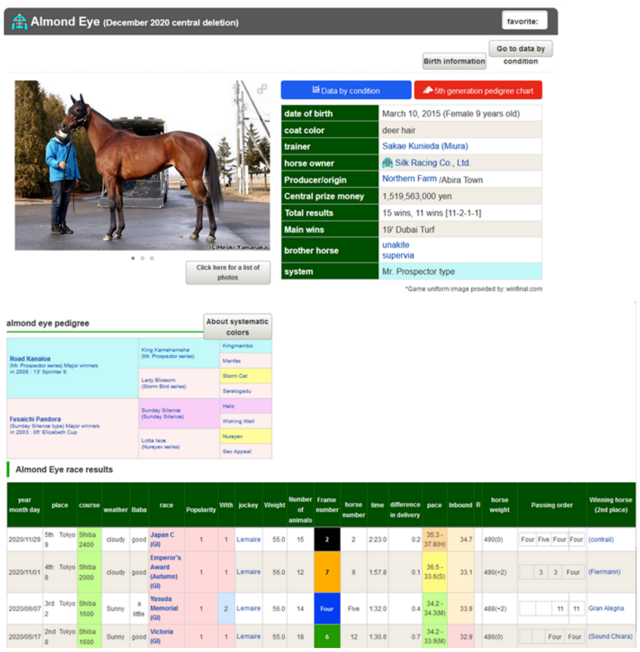


Figure 1. An example of horse information provided by Keiba Lab.

is important to discuss how and why experts made mistakes. Yerkes and Dodson studied the relationship between arousal and performance and showed that a little stress can help we perform a task, however, too much stress degrades our performance [14]. Weinschenk used Alex Rodriguez as an example to show that even experts can make mistakes when the stakes are high [15]. However, experts have a wealth of knowledge and experience, and usually have staff to share their stresses and consider issues with them. Aircraft pilots are under a great deal of mental stress when they are flying their planes. Shappell and Wiegmann focused on preventing errors in aviation, including decision errors, and propose a framework for analyzing and classifying human errors [16]. Kang and Yoon studied the types of errors that both younger and older adults make when learning how to use new technologies [17]. They found that older adults used different strategies than younger adults. However, they did not report how experts made mistakes. Bechara et al. studied unconscious mental processing and reported unconscious minds picked up danger first [18]. However, they did not study whether unconscious minds affect experts' expectations.

III. A COLLECTION OF RACEHORSE INFORMATION

Keiba Lab [19] is one of the most popular horse racing information sites in Japan. This site records various information about all racehorses registered with Japan Racing Association (JRA) and registered users can freely access it. Figure 1 shows an example of horse information provided by Keiba Lab. As shown in Figure 1, the horse information provided by Keiba Lab consists of personal information and race results. Personal data consists of name, date of birth, age, sex, coat color, breeder, birth place, owner, trainer, ancestors up to three generations ago, sire line, career statistics, career prize money, and so on. Race results consist of venue, event date, distance, weather, racetrack, surface, race name, favourite, order of finish, jockey, weight, horse number, frame number, time, and so on. In order to discuss whether horse racing experts have inconsistent expectations on their professional issue, we collected information about 36922 horses registered with JRA from 2010 to 2017 from Keiba Lab. Table I shows the number of horses registered with JRA from 2010 to 2017.

TABLE I
THE NUMBER OF HORSES REGISTERED WITH JRA FROM 2010 TO 2017.

year	number of registered horses
2010	4470
2011	4524
2012	4505
2013	4595
2014	4672
2015	4663
2016	4738
2017	4755
Total	36922

On Keiba Lab, various sire lines are used to classify horses. We surveyed how racehorse sire lines diverged and grouped them into

- Native Dancer Line,
- Nearctic Line,
- Royal Charger Line, and
- others.

For example, Figure 1 shows that the sire line of *Almond Eye* was Mr. Prospector Line. It branched out from Native Dancer Line. As a result, in this study, we determined that the sire line of *Almond Eye* was Native Dancer Line. Then, we classified 36922 horses registered with JRA from 2010 to 2017 into these four types. Table II shows the number of horses classified into these four sire line types. As shown in Table II, 90 percent of the 36922 horses were classified into the three main sire lines: Native Dancer Line, Nearctic Line, and Royal Charger Line.

TABLE II
THE NUMBER OF HORSES CLASSIFIED INTO THE THREE MAIN SIRE LINE TYPES.

sire line	number of horses
Native Dancer Line	8799
Nearctic Line	6383
Royal Charger Line	18104
others	3636
Total	36922

36922 horses had competed in races of various distances. We grouped the race distances into five types: 1000 – 1399m, 1400 – 1799m, 1800 – 2199m, 2200 – 2799m, and more than 2800m. Then, we investigated which distance races and how many times the 36922 horses had competed in. For example, *Almond Eye* had competed in one 1000–1399m race, six 1400–1799m races, four 1800–2199m races, and four 2200 – 2799m races. Table III shows the distance and number of races the

TABLE III
THE DISTANCE AND NUMBER OF RACES THE 36922 HORSES HAD COMPETED IN.

	race distance 1000-1399m	1400-1799m	1800-2199m	2200-2799m	2800m-	Total
number of races	5144	7433	7247	2083	1244	23151

TABLE IV
THE NUMBER OF TIMES THE 36922 HORSES OF FOUR SIRE LINES HAD COMPETED IN RACES OF VARIOUS DISTANCES.

sire line	race distance 1000-1399m	1400-1799m	1800-2199m	2200-2799m	2800m-	Total
Native Dancer	27008	31619	28568	4173	2511	93879
Nearctic	18710	22444	20072	2838	1647	65711
Royal Charger	42525	67514	71758	13181	5848	200826
others	9879	12058	10780	1817	876	35410
Total	98122	133635	131178	22009	10882	395826

TABLE V
THE NUMBER OF HORSES OF FOUR SIRE LINES HAD COMPETED IN RACES OF VARIOUS DISTANCES.

sire line	race distance 1000-1399m	1400-1799m	1800-2199m	2200-2799m	2800m-
Native Dancer	5045	7135	5599	1269	574
Nearctic	3641	5102	4053	1005	395
Royal Charger	8807	14666	13074	3794	1320
others	2056	2844	2312	561	207
Total	19549	29747	25038	6629	2496

TABLE VI
THE NUMBER OF TIMES THE 36922 HORSES OF FOUR SIRE LINES HAD FINISHED IN FIRST PLACE IN THE RACES OF VARIOUS DISTANCES.

sire line	race distance 1000-1399m	1400-1799m	1800-2199m	2200-2799m	2800m-	Total
Native Dancer	1947	2261	2121	341	188	6858
Nearctic	1347	1511	1399	206	143	4606
Royal Charger	2580	4767	5496	1078	495	14416
others	677	855	671	105	52	2360
Total	6551	9394	9687	1730	878	28240

TABLE VII
THE NUMBER OF TIMES THE 36922 HORSES OF FOUR SIRE LINES HAD FINISHED IN TOP FIVE PLACE IN THE RACES OF VARIOUS DISTANCES.

sire line	race distance 1000-1399m	1400-1799m	1800-2199m	2200-2799m	2800m-	Total
Native Dancer	9345	10912	10552	1748	1120	33677
Nearctic	6462	7700	7112	1070	728	23072
Royal Charger	13893	23937	26949	5369	2713	72861
others	3203	4054	3564	655	317	11793
Total	32903	46603	48177	8842	4878	141403

36922 horses had competed in. Table IV shows the number of times the 36922 horses of four sire lines had competed in races of various distances. Table V shows the number of horses of four sire lines had competed in races of various distances.

Horse owners get prize money when their horses place in the top five in races held by JRA. As a result, we investigated which distance races and how many times the 36922 horses of four sire lines had finished in first place and top five place in races held by JRA. Tables VI and VII show the number of times the 36922 horses of four sire lines had finished in first place and top five place in the races of various distances, respectively.

IV. ANALYSIS OF INCONSISTENT EXPECTATIONS OF HORSE RACING EXPERTS

Horse racing experts have the problem of which distance races are favorable or unfavorable for racehorses of a certain sire line. Also, they have expectations on this problem. In this section, we investigate whether horse racing experts have inconsistent expectations on this problem.

A. Basic idea

It is widely recognized that inherited variation in physical and physiological characteristics is responsible for variation in individual aptitude for race distance. Many horse racing experts would agree that if the best race distance of ancestors is known, the offspring's best race distance is most likely to take after them. As a result, we focus on three factors of racehorses:

- sire line,
- race distance, and
- order of finish.

In this section, we first investigate whether horse racing experts entered their horses of certain sire lines in races of certain distances too many times or too few times. The result of this investigation shows which distance races the experts thought were favorable or unfavorable for racehorses of a certain sire line. Then, we investigate whether horses of certain sire lines won or lost races of certain distances too many times. The result of this investigation shows which distance races were fovorable or unfavorable for racehorses of a certain sire line. Next, we investigate whether horse racing experts entered their horses into races of a certain distance too many times. The result of this investigation shows experts' judgements of horses' performance. Finally, we compare the results of statistical analyses on experts' race selection, the race results, and experts' judgements of horses' performance, and detect inconsistent expectations of horse racing experts.

B. Detection of race distance and sire line combinations that horse racing experts selected too many times or too few times

In order to detect cases where horse racing experts entered their horses of certain sire lines into races of certain distances too many times or too few times, we conduct the statistical analysis by using Hypothesis *ES*.

Hypothesis *ES* If experts did not enter too many times or too few times their racehorses of certain sire lines into races of certain distances, we would expect that experts entered their horses of sire line s_i into races of distance d_j at most

TABLE VIII
THE P-VALUES OF EXPERTS' RACE SELECTIONS FOR HORSES OF NATIVE DANCER LINE, NEARCTIC LINE, AND ROYAL CHARGER LINE.

sire line	race distance				
	1000–1399m	1400–1799m	1800–2199m	2200–2799m	2800m–
Native Dancer	1.0000	0.3024	0.0000	0.0000	0.0825
Nearctic	1.0000	0.9835	0.0000	0.0000	0.0001
Royal Charger	0.0000	0.0882	1.0000	1.0000	0.9999

$N_{ES}(s_i, d_j)$ times

$$N_{ES}(s_i, d_j) = P_{ES}(d_j) \times \sum_j N_{entry}(s_i, d_j) \quad (1)$$

where d_j is the type of race distance. We classified race distances into five types:

d_1	1000 – 1399m
d_2	1400 – 1799m
d_3	1800 – 2199m
d_4	2200 – 2799m
d_5	2800m –

$N_{entry}(s_i, d_j)$ is the number of times horses of sire line s_i were entered into races of distance d_j, as a result, $\sum_j N_{entry}(s_i, d_j)$ is the total number of times horses of sire line s_i were entered into races. $P_{ES}(d_j)$ is the probability that an expert enters his/her horse into a race of distance d_j. $P_{ES}(d_j)$ is

$$P_{ES}(d_j) = \frac{\sum_i N_{entry}(s_i, d_j)}{\sum_i \sum_j N_{entry}(s_i, d_j)} \quad (2)$$

where $\sum_i N_{entry}(s_i, d_j)$ is the total number of times horses were entered into races of distance d_j and $\sum_i \sum_j N_{entry}(s_i, d_j)$ is the total number of times horses were entered into races.

If this hypothesis is rejected by an two-sided binomial test [20], we determine that experts entered their horses of sire lines s_i into races of distance d_j too many times or too few times.

C. Detection of race distance and sire line combinations that gave good or poor results for racehorse experts too many times

In order to detect cases where horses of certain sire lines won or lost races of certain distances too many times, we conduct the statistical analysis by using Hypothesis *RR*.

Hypothesis *RR* If horses of certain sire lines did not perform well too many times or too few times in races of certain distances, we would expect that horses of sire line s_i finished within $rank$-th place in races of distance d_j at most $N_{RR}(s_i, d_j, rank)$ times

$$N_{RR}(s_i, d_j, rank) = P_{RR}(d_j, rank) \times N_{entry}(s_i, d_j) \quad (3)$$

TABLE IX
THE P-VALUES OF RACE RESULTS OF HORSES OF NATIVE DANCER LINE, NEARCTIC LINE, AND ROYAL CHARGER LINE.

(a) Native Dancer Line

result	race distance				
	1000–1399m	1400–1799m	1800–2199m	2200–2799m	2800m–
first place	0.9997	0.8036	0.6069	0.7820	0.1506
top five place	0.9999	0.0890	0.7712	0.9542	0.1472

(b) Nearctic Line

result	race distance				
	1000–1399m	1400–1799m	1800–2199m	2200–2799m	2800m–
first place	0.9978	0.0412	0.0123	0.1230	0.8318
top five place	0.9982	0.0381	0.0001	0.0013	0.1528

(c) Royal Charger Line

result	race distance				
	1000–1399m	1400–1799m	1800–2199m	2200–2799m	2800m–
first place	0.0000	0.6279	0.9975	0.9145	0.8717
top five place	0.0001	0.9992	1.0000	0.9298	0.9889

where d_j is the type of race distance. We classified race distances into five types in the same way that we did in Hypothesis *ES*. $N_{entry}(s_i, d_j)$ is the number of times horses of sire line s_i were entered into races of distance d_j. $P_{RR}(d_j, rank)$ is the probability that a horse finished within $rank$-th place in a race of distance d_j. $P_{RR}(d_j, rank)$ is

$$P_{RR}(d_j, rank) = \frac{\sum_i N_{result}(s_i, d_j, rank)}{\sum_i N_{entry}(s_i, d_j)} \quad (4)$$

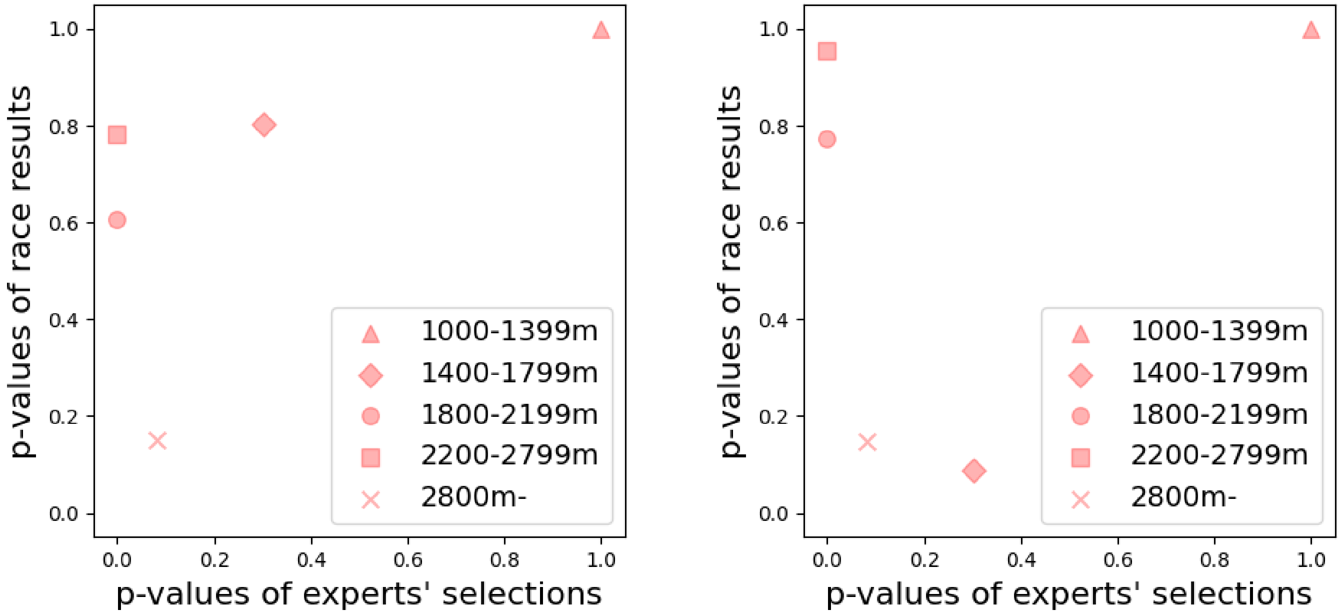
where $N_{result}(s_i, d_j, rank)$ is the number of times horses of sire line s_i finished within $rank$-th place in races of distance d_j. As a result, $\sum_i N_{result}(s_i, d_j, rank)$ is the total number of times horses finished within $rank$-th place in races of distance d_j. Furthermore, $\sum_i N_{entry}(s_i, d_j)$ is the total number of times horses were entered into races of distance d_j.

If this hypothesis is rejected by an two-sided binomial test, we determine that horses of sire line s_i finished too many times or too few times within $rank$-th place in races of distance d_j.

D. Detection of horses that horse racing experts judged to have performed well

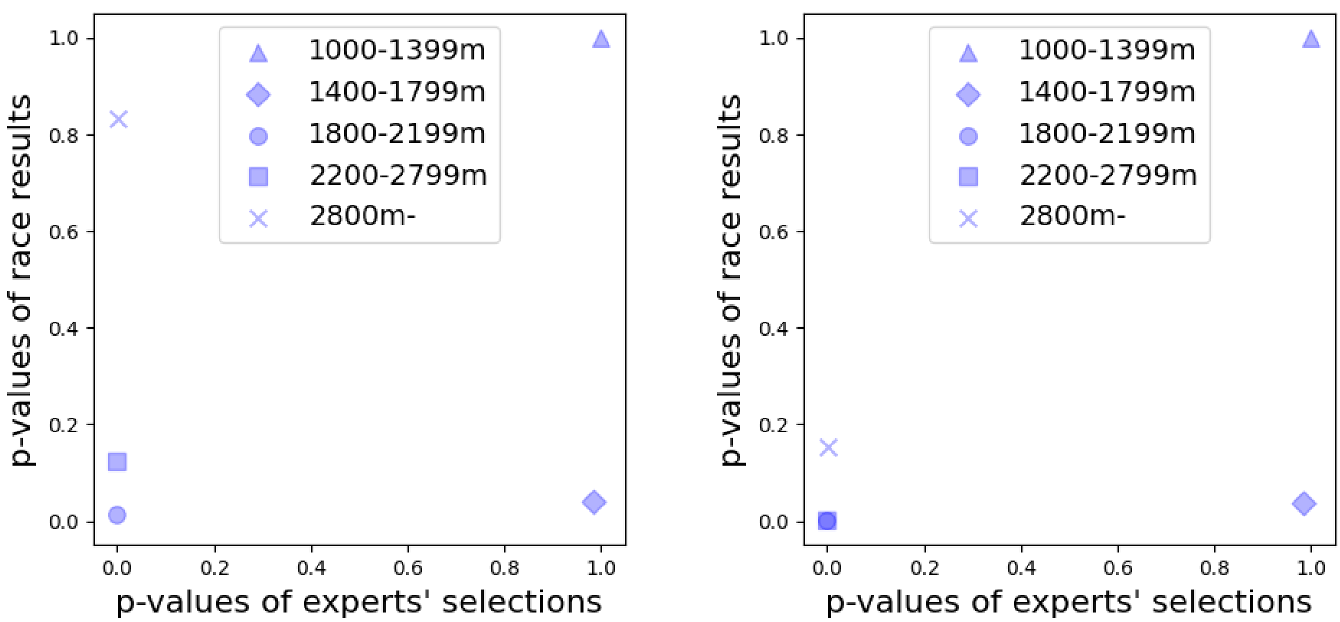
If a horse perform well in a race of a certain distance, experts will try to enter the horse into another race of a similar distance. As a result, if horses are judged to have performed well in races of a certain distance, experts may enter them into races of a similar distance repeatedly. In order to detect cases where horse racing experts entered their horses into races of certain distances too many times or too few times, we conduct the statistical analysis by using Hypothesis *EJ*.

Hypothesis *EJ* If an expert did not enter too many times or too few times his/her racehorse of a certain sire line into races



(a) first place (b) top five place

Figure 2. The p-values of experts' race selections vs race results (Native Dancer Line).



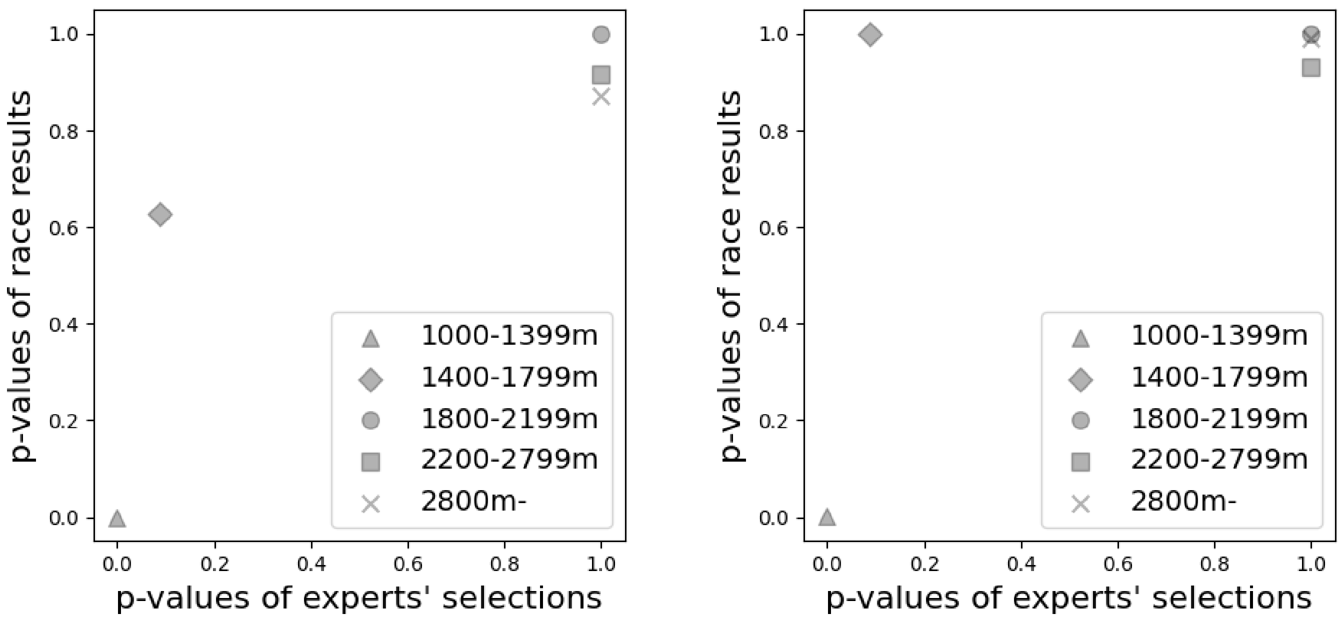
(a) first place (b) top five place

Figure 3. The p-values of experts' race selections vs race results (Nearctic Line).

of a certain distance, we would expect that the expert entered horse h_k into races of distance d_j at most $M_{EJ}(h_k, d_j)$ times

$$M_{EJ}(h_k, d_j) = P_{EJ}(s_i, d_j) \times \sum_j M_{entry}(h_k, d_j) \quad (5)$$

where s_i is the sire line of horse h_k and d_j is the type of race distance. We classified race distances into five types in the same way that we did in Hypothesis *ES*. $\sum_j M_{entry}(h_k, d_j)$ is the number of times horse h_k were entered into races. $P_{EJ}(s_i, d_j)$ is the probability that an expert enters a horse



(a) first place (b) top five place

Figure 4. The p-values of experts' race selections vs race results (Royal Charger Line).

of sire line s_i into a race of distance d_j. $P_{EJ}(s_i, d_j)$ is

$$P_{EJ}(s_i, d_j) = \frac{N_{entry}(s_i, d_j)}{\sum_j N_{entry}(s_i, d_j)} \quad (6)$$

where $N_{entry}(s_i, d_j)$ is the number of times horses of sire line s_i were entered into races of distance d_j. As a result, $\sum_i N_{entry}(s_i, d_j)$ is the total number of times horses were entered into races of distance d_j.

If this hypothesis is rejected by an two-sided binomial test [20], we determine that an expert entered his/her horse h_k of sire lines s_i into races of distance d_j too many times or too few times.

E. Results of the investigation

In order to investigate whether horse racing experts have inconsistent expectations, we apply Hypothesis *ES*, *RR*, and *EJ* tests on

- the 8799 horses of Native Dancer Line,
- the 6383 horses of Nearctic Line, and
- the 18104 horses of Royal Charger Line

registered with JRA from 2010 to 2017, as shown in Table I. The significance levels for Hypothesis *ES*, *RR*, and *EJ* were 0.05. First, we calculated the p-values of experts' race selections, the race results, and experts' judgements of horses' performance by applying Hypothesis *ES*, *RR*, and *EJ*, respectively. Table VIII shows the p-values of experts' race selections for horses of Native Dancer Line, Nearctic Line, and Royal Charger Line. Table IX shows the p-values of race results (first place and top five place) of horses of Native Dancer Line, Nearctic Line, and Royal Charger Line. Figure 2, Figure 3, and Figure 4 show the p-values of experts' race selections vs the race results (first place and top five place) for horses of Native Dancer Line, Nearctic Line, and Royal Charger Line, respectively. Table X and Table XI show the number of

- horses determined by Hypothesis *EJ* to have repeatedly competed in races of various distances, and
- horses determined by Hypothesis *EJ* not to have repeatedly competed in races of various distances,

respectively, and also show

- the number of times the horses had competed in the races, and
- the average number of races the horses had competed in.

Figure 5 shows the percentage of horses competed repeatedly in races of various distances.

First, we consider experts' expectations that their race selections suggested. Table VIII, the results obtained by applying Hypothesis *ES*, shows

- in the case of Native Dancer Line, the p-value of race distance type d_1 (1000 – 1399m) was more than 0.975. As a result, experts entered horses of Native Dancer Line into races of distance type d_1 (1000 – 1399m) too many times. In other words, many experts strongly thought horses of Native Dancer Line were favorable to win in races of distance type d_1 (1000 – 1399m). On the other hand, the p-values of race distance type d_3 (1800 – 2199m) and d_4 (2200 – 2399m) were less than 0.025. In addition, the p-value of race distance type d_5 (2800m –) was low, 0.0825. As a result, many experts strongly thought horses

TABLE X
THE NUMBER OF HORSES DETERMINED BY HYPOTHESIS *EJ* TO HAVE REPEATEDLY COMPETED IN RACES OF VARIOUS DISTANCES AND THE AVERAGE NUMBER OF TIMES THE HORSES HAD COMPETED IN THE RACES.

(a) Native Dancer Line

	race distance				
	1000-1399m	1400-1799m	1800-2199m	2200-2799m	2800m-
horses competed repeatedly	2320	1575	1940	628	376
races competed in	20005	13491	18207	3308	2248
ave. of races competed in	8.6	8.6	9.4	5.3	6.0

(b) Nearctic Line

	race distance				
	1000-1399m	1400-1799m	1800-2199m	2200-2799m	2800m-
horses competed repeatedly	1616	1161	1427	562	274
races competed in	13709	9651	12700	2258	1506
ave. of races competed in	8.5	8.3	8.9	4.0	5.5

(c) Royal Charger Line

	race distance				
	1000-1399m	1400-1799m	1800-2199m	2200-2799m	2800m-
horses competed repeatedly	3973	3403	4445	1637	879
races competed in	32362	30280	42264	9933	5268
ave. of races competed in	8.1	8.9	9.5	6.1	6.0

TABLE XI
THE NUMBER OF HORSES DETERMINED BY HYPOTHESIS *EJ* NOT TO HAVE REPEATEDLY COMPETED IN RACES OF VARIOUS DISTANCES AND THE AVERAGE NUMBER OF TIMES THE HORSES HAD COMPETED IN THE RACES.

(a) Native Dancer Line

	race distance				
	1000-1399m	1400-1799m	1800-2199m	2200-2799m	2800m-
horses competed not repeatedly	2725	5560	3659	641	198
races competed in	7003	18128	10361	865	263
ave. of races competed in	2.6	3.3	2.8	1.3	1.3

(b) Nearctic Line

	race distance				
	1000-1399m	1400-1799m	1800-2199m	2200-2799m	2800m-
horses competed not repeatedly	2025	3941	2626	443	121
races competed in	5001	12793	7372	580	141
ave. of races competed in	2.5	3.2	2.8	1.3	1.2

(c) Royal Charger Line

	race distance				
	1000-1399m	1400-1799m	1800-2199m	2200-2799m	2800m-
horses competed not repeatedly	4834	11263	8629	2157	441
races competed in	10163	37234	29494	3248	580
ave. of races competed in	2.1	3.3	3.4	1.5	1.3

of Native Dancer Line were unfavorable to win in races over 1800m.

- in the case of Nearctic Line, the p-value of race distance type d_1 (1000 – 1399m) and d_2 (1400 – 1799m) were more than 0.975. As a result, many experts strongly thought horses of Nearctic Line were favorable to win in under 1800m races. On the other hand, the p-values of race distance type d_3 (1800 – 2199m), d_4 (2200 – 2399m), and d_5 (2800m –) were less than 0.025. As a result, many experts strongly thought horses of Nearctic Line were unfavorable to win in races over 1800m.
- in the case of Royal Charger Line, the p-value of race distance type d_3 (1800 – 2199m), d_4 (2200 – 2399m), and d_5 (2800m –) were more than 0.975. As a result, many experts strongly thought horses of Royal Charger Line were favorable to win in races over 1800m. On the other hand, the p-values of race distance type d_1 (1000 – 1399m) were less than 0.025. In addition, the p-value of race distance type d_2 (1400 – 1799m) was low, 0.0890. As a result, many experts strongly thought horses of Royal Charger Line were unfavorable to win in races under 1800m.

Next, we consider experts' expectations that the average number of races competed by horses suggested. Figure 6 shows the average number of races competed by

- horses determined by Hypothesis *EJ* to have repeatedly competed in races of a certain distance and
- horses determined by Hypothesis *EJ* not to have repeatedly competed in races of that distance.

For example, in the case of Native Dancer Line, the average number of races of distance type d_5 (2800m –) competed by horses determined not to have repeatedly competed in races of that distance was 1.3. Figure 6 shows that, in all three sire lines, the average number of races of distance type d_4 (2200 – 2399m) and d_5 (2800m –), in other words, the average number of races over 2200m competed by horses determined not to have repeatedly competed in races of that distance was 1.5 or less. On the other hand, the average number of races under 2200m competed by horses determined not to have repeatedly competed in races of that distance was 2.1 or more. As a result, experts had to decide whether or not to continue to enter their horses in races over 2200m based on the results of almost one race, regardless of sire line. On the other hand, they could decide whether or not to continue to enter their horses in races under 2200m based on the results of two races or more. We thought that the reason for this difference was that the number of races over 2200m was small compared to that of races under 2200m. Table III shows that races over 2200m accounted for 14% of all races. As a result, we focus on races under 2200m.

First, we consider horses of Royal Charger Line determined not to have repeatedly competed in races under 2200m. Figure 6 shows that

- the average number of races of distance type d_1 (1000 – 1399m) was 2.1.
- the average number of races of distance type d_3 (1800 – 2199m) was 3.4.

The reason for this difference is thought to be that many experts want to decide whether or not to continue to enter their horses in unfavorable races based on the results of as

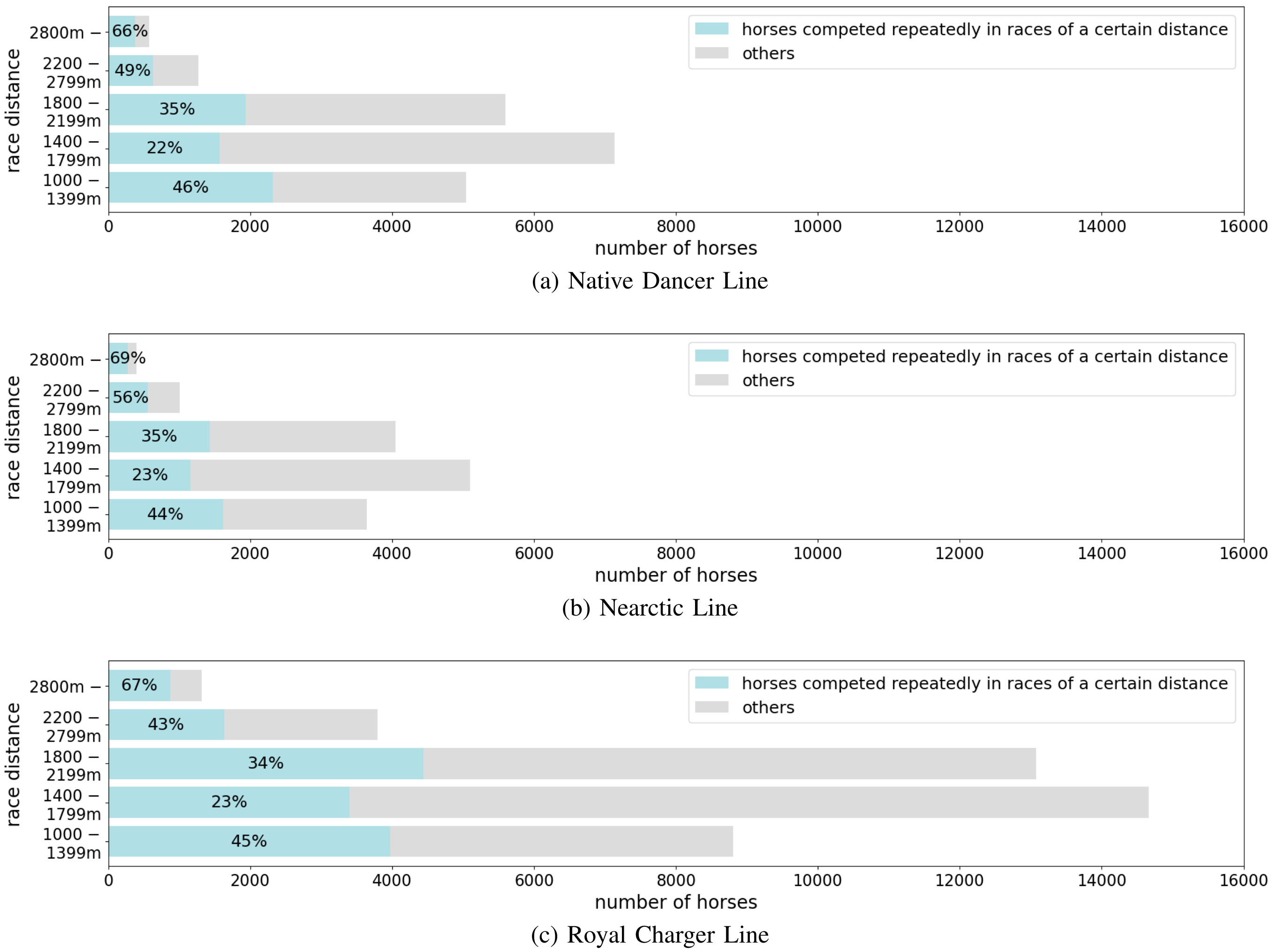


Figure 5. The percentage of horses competed repeatedly in races of various distances.

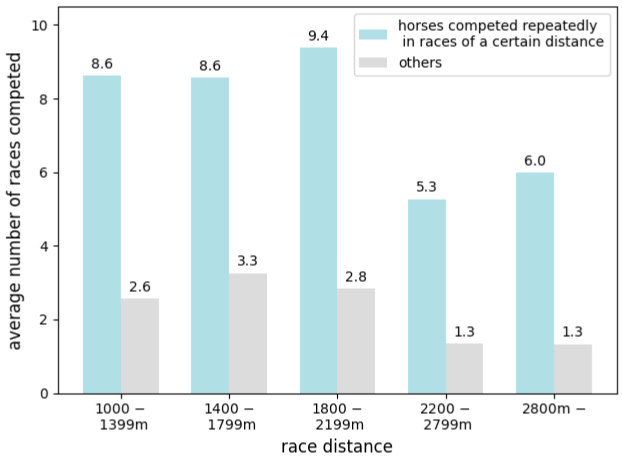
few races as possible. As mentioned, many experts thought that horses of Royal Charger Line were unfavorable to win in races of distance type d_1 (1000 – 1399m), on the other hand, they were favorable to win in races of distance type d_3 (1800 – 2199m). As a result, we thought that the average number of races at which experts decide whether to continue to enter their horses in races of distance type d_1 (1000 – 1399m) was fewer than that in races of distance type d_3 (1800 – 2199m). The point to note is the average number of races of distance type d_2 (1400 – 1799m). As shown in Figure 6, it was 3.3 and almost the same as the average number of races of distance type d_3 (1800 – 2199m). However, many experts thought that horses of Royal Charger Line were unfavorable to win in races of distance type d_2 (1400 – 1799m), on the other hand, they were favorable to win in races of distance type d_3 (1800 – 2199m). As a result, we thought that, in the case of Royal Charger Line, experts' expectations were inconsistent for races of distance type d_2 (1400 – 1799m).

Next, we consider horses of Native Dancer Line and Nearctic Line determined not to have repeatedly competed in races under 2200m. Figure 6 shows that, in both cases, the average number of races of distance type d_1 (1000 – 1399m) was almost the same as that of races of distance type d_3 (1800 – 2199m). However, horses of Native Dancer Line and Nearctic Line were favorable to win in races of distance type d_1 (1000 – 1399m), on the other hand, they were unfavorable to win in races of distance type d_3 (1800 – 2199m). As a result, we thought that, in the case of Native Dancer Line and Nearctic Line, experts' expectations were inconsistent for races under 2200m.

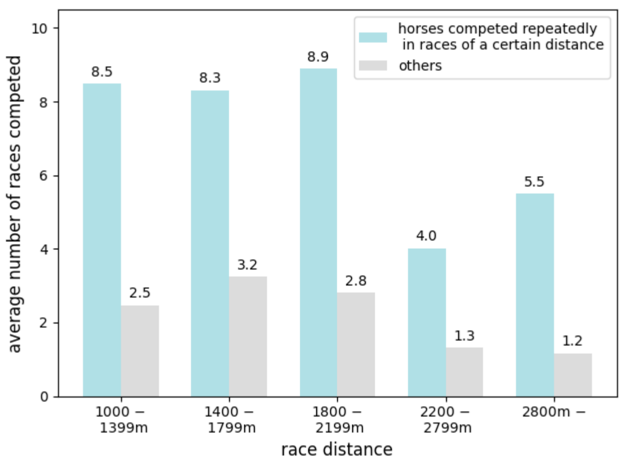
We thought the reason for this inconsistent expectations is that many experts did not consider sire lines when deciding whether to continue to enter their horses in another race of a similar distance as they do when selecting race distance. It suggests that statistical analysis may be able to resolve experts' inconsistent expectations and improve their performance.

V. Conclusion

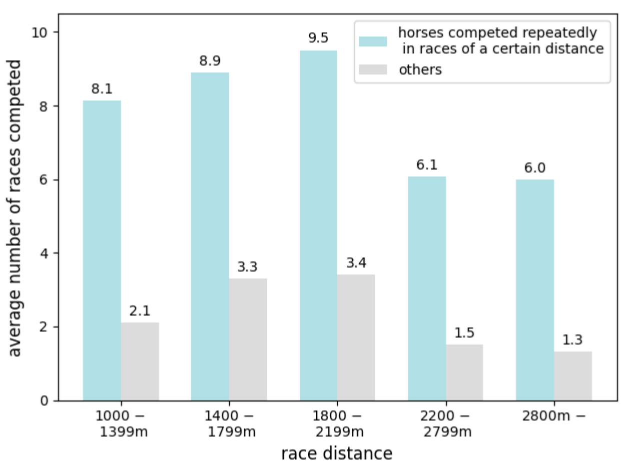
Although experts have a wealth of knowledge and experience, they sometimes make mistakes. However, not enough



(a) Native Dancer Line



(b) Nearctic Line



(c) Royal Charger Line

Figure 6. The average number of times horses determined by Hypothesis *EJ* to have and not have repeatedly competed in races of various distances.

research has been done on how and why experts made mistakes. We thought that one of the reasons why they made mistakes is that they have inconsistent expectations. As a result, in this paper, we investigated whether horse racing experts have inconsistent expectations on their professional issue. We analyzed sire lines, race distances, and race results of the 36922 horses statistically and showed that horse racing experts had inconsistent expectations on the problem of which race distance they thought were favorable for horses of a certain sire line. We think this is because many horse racing experts did not consider sire lines when deciding whether to continue to enter their horses in another race of a similar distance as they do when selecting race distance. As a result, statistical analysis may be able to resolve experts' inconsistent expectations and improve their performance.

To generalize this finding, we intend to analyze race performance data from other time periods and compare the results with those obtained in this study.

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