

Examining regional and familiarity bias of referees in USA Fencing

Division I bouts

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3 **Abstract**

4 This study examines whether USA Fencing referees exhibit favoritism toward competitors from their
5 designated regions, as frequent officiating within local areas could establish familiarity and
6 potentially lead to unconscious bias. This issue is particularly relevant in foil and saber, where
7 referees make subjective judgments on "right-of-way" during simultaneous hits, and in epee, where
8 penalty decisions hold significant weight. Unlike other sports with subjective scoring that utilize
9 referee panels, fencing relies on a single referee, granting them considerable control over bout
10 outcomes. Despite the opportunity for prejudice, there are no studies of referee bias in fencing; this
11 study aims to be the first to do so. Utilizing a substantial dataset of 35,111 Division I pool bouts from
12 2012 to 2019, I applied linear and logistic regression models to analyze the effect of regionality on
13 score differentials and bout outcomes. The results revealed limited evidence of regional bias, with
14 nonsignificant negative effects in foil and saber and a minimal positive effect in epee. These findings
15 diverge from similar studies in other sports, suggesting that regular referee-player interactions do not
16 necessarily result in biased officiating. The minimal positive effect in epee suggests the need for
17 further investigation into how decision-making may differ between scoring and penalty calls.
18 Additionally, the findings highlight the necessity for more research on how referees' relationships
19 with players influence their judgments.

20 **Keywords:** regional bias, familiarity bias, fencing, referee, discrimination, official, linear regression,
21 logistic regression, referee bias

22 1 Introduction

23 Fencing referees wield significant influence, acting as the sole arbiters who give penalties, judge
24 ambiguous touches, award points, and ultimately shape the outcome of a bout. Recently, the
25 subjectivity of fencing refereeing has come under scrutiny. On April 24, 2024, USA Fencing
26 suspended two referees (Wendell, 2024) who had “acknowledged communicating with each other
27 during an Olympic qualifying tournament in California” (Longman, 2024). It grew so concerned
28 about two other referees that it asked the sport’s global governing body to “ensure that those two
29 judges were no longer assigned to any matches involving Americans.” Historically, fencing
30 refereeing has always been subjective. In the 1900s, fencing was not electrified, requiring fencers to
31 persuade two side judges about the legitimacy of their hits. These judges would then communicate
32 their opinions to the main referee, who made the final decision. The subjective aspect of judging hits
33 created many opportunities for officials to cheat (Cohen, 2003).

34 Despite the advent of electronic scoring for all fencing weapons in recent decades, fencing
35 refereeing remains subjective. In foil and saber, the referee plays a crucial part due to the "right-of-
36 way" or “priority” rule, a subjective system determining which fencer scores a point when two
37 fencers land hits simultaneously. Czajkowski (2009) succinctly describes this dynamic: “in offensive
38 actions, [the fencer] fights to be ahead in gaining the right-of-way: he must be first to initiate the
39 attack (not only in his own but, above all, in the referee’s opinion).” While the concept of "right-of-
40 way" is straightforward, its nuances are intricate and challenging to quantify. Due to the complexity
41 of determining priority, a referee is responsible for making the decisive call on points at tournaments.
42 This responsibility makes fencing bouts particularly susceptible to referee bias, as a biased referee
43 may choose not to award a point to a fencer who initiates a well-defined attack. Crucially, priority
44 decisions must be made within seconds, and fencing actions occur at high speeds, requiring referees
45 to process complex information and render judgments almost instantaneously. This time pressure
46 adds another layer of complexity to the referee's task and potentially increases susceptibility to bias.

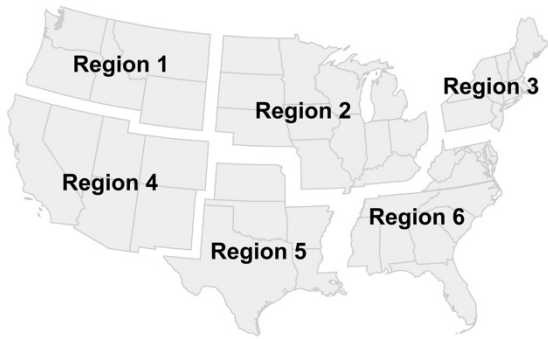
47 However, referees can make subjective decisions even in the absence of “right-of-way.” In
48 epee fencing, where both fencers get a point on simultaneous hits, referees still maintain the authority
49 to subjectively issue penalties for common infractions or situations. For example, a referee needs to
50 distinguish between “jostling,” which incurs a penalty, and incidental body contact between fencers,
51 which does not result in a penalty. This scenario is like soccer, where players are permitted to use
52 their body to gain control over the ball but are prohibited from pushing or shoving their opponents.
53 Minor and first-time infractions lead to an issuance of a yellow card, serving as a warning without
54 impacting the score. Major infractions or repeated offenses lead to a red card, awarding the opponent
55 an additional point. Rarely, egregious offenses can lead to black cards, resulting in exclusion from
56 the tournament. With rare exceptions, such as late-stage bouts featuring video replay (where the
57 referee still holds final authority), fencers are generally prohibited from contesting rulings on priority
58 and penalty calls. At the elite Division I level tournaments—events significant for Olympic selection
59 and NCAA recruitment—referees' decisions can have considerable ramifications on the trajectory of
60 athletes' careers.

61 There is a wealth of literature examining referee bias, primarily in mainstream sports such as
62 soccer and basketball. Studies in other sports have presented many ways that referees can be
63 influenced, such as home-court bias (Boyko et al., 2007), racial bias (Magistro & Wack, 2023),
64 nationalistic bias (Lyngstad et al., 2020), linguistic bias (Faltings et al., 2023), reputation bias (Bose
65 et al., 2021), and referee-team familiarity bias (Hlasny & Kolaric, 2015). However, the niche sport of
66 fencing has received little attention in this regard, with scant research on referee bias. Despite modern
67 fencing dating back to the 18th century and being one of the few sports included in every modern
68 Olympic Games, officiating bias remains surprisingly understudied. Existing literature on fencing
69 bias relies on surveys of referees and fencers (Abdelfatah et al., 2022), or attempts to automate
70 refereeing (Mo, 2022; Sunal et al., 2021). This study aims to be the first to investigate the presence
71 and extent of referee bias in fencing competitions. Fencing offers a unique case study due to the

72 significant influence a single referee wields over the bout. In contrast to other sports with subjective
73 scoring, such as gymnastics or ski jumping, which utilize referee panels to mitigate the impact of an
74 individual referee's preferences, fencing relies solely on a single referee, granting them substantial
75 control over the final score. Therefore, the magnitude of referee bias can be greater in fencing than in
76 other sports.

77 The Fédération Internationale d'Esgrime is the international governing body for the sport of
78 fencing, and USA Fencing is the national governing body for fencing in the United States. This
79 national body has roughly 35,000 members, including competitive fencers and individuals such as
80 referees, coaches, and other active participants. These members belong to one of nearly 70 local
81 divisions based on their location of residence. Each division falls under one of six geographic regions
82 established by USA Fencing as illustrated in Figure 1. These regions play a vital role in qualifying
83 athletes for prestigious national tournaments like the Junior Olympics and National Championships.
84 To qualify, fencers must amass a minimum number of regional points, which are exclusively earned
85 at tournaments within their designated region. With approximately 20 regional events occurring
86 annually in each of the six geographic regions, fencers and coaches often travel to different divisions
87 to accumulate points. Additionally, to address the shortage of referees at regional-level tournaments,
88 organizers bring in officials from other divisions. As a result, fencers, coaches, and referees within
89 the same region connect through frequent interactions, gradually becoming acquainted and familiar
90 over time.

91 Figure 1: USA Fencing region map.



92

93 National-level fencing tournaments attempt to balance fairness with practicality. While referees are
94 barred from officiating athletes from their local division due to conflict-of-interest concerns, they can
95 officiate athletes from their broader region. This raises concerns about potential subconscious bias.
96 Research in other sports, such as Hlasny and Kolaric's (2015) study on soccer referees, demonstrated
97 how familiarity can lead to systematic biases. Their findings suggested that referees awarded fewer
98 cards to teams they were more familiar with, and older referees, presumably with deeper existing
99 relationships, displayed greater home-advantage bias. They also argued that other trends of bias (such
100 home-court, racial, and prestige bias), could be attributable to "implicit lifelong bonds between
101 referees and players." Similar findings emerged in baseball, where Mills (2013) demonstrated that
102 catchers, who have frequent interactions with the umpire, received fewer strike calls when batting
103 compared to other players. Moreover, Emerson et al. (2009) proposed that stylistic bias could
104 contribute to nationalistic bias in Olympic diving.

105 In fencing, referees' familiarity with clubs and fencers in their region could introduce
106 unintended biases. Having observed prior performances, referees may unconsciously form
107 preconceived notions about a fencer's technique or style. Bias may also emerge from a preference for
108 common regional fencing styles. Additionally, psychological phenomena such as the "mere exposure
109 effect" (Zajonc, 1968) could play a role, where repeated exposure to familiar fencers might lead to
110 more favorable judgments. To investigate potential regional bias in fencing referees, I analyze score
111 differentials and bout outcomes using linear and logistic regression. The hypothesis is that, in the

112 presence of regional bias, fencers will have a significantly higher score differential and chance of
113 winning when officiated by a referee from their own region.

114 **2 Materials and Methods**

115 I used web scraping to extract Division I pool bouts from USA Fencing's official results website
116 (<https://usfencingresults.org/results/>), over a seven-year span; from October 2012 to December 2019.
117 Pools are groups of 6-7 competitors of varying skill levels that fence a round-robin of 5-touch bouts
118 to determine their seeding for the direct elimination round. Pool bouts do not have video replay, so
119 the referee's decision is final. I chose this timeframe because prior to 2012, USA Fencing did not
120 consistently record the referee's division and post-2019 data was unavailable. I selected the Division
121 I category because the outcomes of these events determine Olympic qualification, and this was the
122 category where the referees had been caught colluding. For each bout, the recorded data included the
123 final score, outcome (win/loss), divisions of both fencers, and the referee's division. I also mapped
124 each person's division to its respective region. Since the outcome depends on the bout's perspective,
125 the primary fencer for each bout was randomized.

126 I restricted my focus to non-championship Division I national events with one round of pools to
127 ensure homogeneity of pool bouts across events. Championship events have higher qualification
128 standards, and top fencers only participate in the second round of events with two rounds of pools,
129 potentially altering bout characteristics. I also excluded pools with two referees listed because it was
130 unclear which referee oversaw each bout (they alternate refereeing bouts in a nonsystematic way).
131 Since men's and women's events occur concurrently at the same location with the same referees and
132 had similar bout score distributions, I consolidated bouts from both genders. I assumed referee bias
133 would be consistent across genders. However, I analyzed the three fencing weapons separately due to
134 their distinct rulesets. My final dataset consisted of 14,011 foil bouts, 10,575 epee bouts, and 10,525

135 saber bouts. Of these, 2,344 foil bouts (17%), 1,584 epee bouts (15%), and 2,282 saber bouts (22%)
136 had a referee and fencer from the same region.

137 The automated system that assigns referees to pools does not consider regional affiliation,
138 except for preventing referees from officiating fencers from their own division. I exploit this quasi-
139 random assignment to isolate and examine potential regional bias in referee decisions. By leveraging
140 the randomness in referee-pool assignments, I ensure that any observed effects are not a result of
141 systematic bias in the assignment process. To measure the effect of a fencer and referee being from
142 the same region, I used linear and logistic regression with heteroskedasticity-robust standard errors.
143 My specification is as follows:

$$144 Y_i = \beta_0 + \beta_1 \text{Primary fencer and referee from same region}_i + \beta_2 \text{Primary fencer region}_i + \\ 145 \beta_3 \text{Event gender}_i + \beta_4 \text{Primary fencer region}_i * \text{Event gender}_i + \varepsilon_i$$

146 In the linear regression, my outcome variable is the score differential in bout i , which is measured as
147 the primary fencer's score minus their opponent's score. In the logistic regression, my outcome
148 variable is whether the primary fencer won bout i . The categorical covariate for region adjusts for the
149 variation in fencer population and skill between regions. For example, Region 3 foil fencers win 53%
150 of their bouts, whereas Region 6 foil fencers win 37% of their bouts; additionally, Region 3 fencers
151 are overrepresented among bouts where a fencer and referee are from the same region. The
152 interaction term with gender allows for variation in average regional skill between male and female
153 events. Note that fencers and referees who are not from the United States (and do not have a region)
154 are not counted as being from the same region.

155 **3 Results**

156 Table 1 provides summary statistics for the characteristics of the primary fencers, referees, and event
157 genders of the 35,111 Division I pool bouts from 2012-2019. Regions varied substantially in their
158 populations of both referees and fencers.

159 Table 1: Summary statistics.

Variable	Foil	Epee	Saber
# of total bouts	14011	10575	10525
# of bouts from a men's event	8856	6921	5931
# of bouts where primary fencer from			
No region (foreign fencer)	1515	964	849
Region 1	373	385	569
Region 2	1241	1063	501
Region 3	5953	3411	4391
Region 4	3066	2273	2224
Region 5	646	1370	346
Region 6	1217	1109	1645
# of bouts where referee is from			
No region (foreign referee)	1032	561	1542
Region 1	1518	975	480
Region 2	1752	1458	720
Region 3	3840	2862	4416
Region 4	2247	1956	1947
Region 5	1332	999	384
Region 6	2290	1764	1036
# of bouts where both primary fencer and referee are from			
Region 1	29	23	17
Region 2	135	113	35
Region 3	1510	859	1743
Region 4	465	351	347
Region 5	48	92	6
Region 6	157	146	134

160 Table 2 presents the linear and logistic regression results examining the effect of regional affiliation
161 on referee decisions across the three fencing weapons. Contrary to initial expectations, the data
162 provided limited evidence of general favoritism by referees toward fencers from their own region. In
163 both models, the effect of the referee and primary fencer being from the same region was slightly
164 negative and nonsignificant for foil and saber. This suggests that having a referee from the same
165 region did not confer an advantage to foil and saber fencers in terms of scoring or the likelihood of
166 winning a bout. In epee, a positive effect was observed, but it was only significant at the $p < 0.1$

167 level. Although this effect was only marginally significant, this could indicate that epee fencers with
 168 referees from the same region have a slight advantage: approximately one point every seven bouts.

169 Table 2: Linear and logistic regressions on the score differential and log odds ratio of victory.

Weapon	Foil		Epee		Saber	
	β	SE	β	SE	β	SE
Effect of referee and fencer being from same region on score difference	-0.0368	0.073	0.1387*	0.075	-0.0034	0.076
Effect of referee and fencer being from same region on log odds of winning	-0.0058	0.047	0.1070*	0.056	-0.0289	0.052

170 The coefficients for the other variables are omitted for succinctness. * $p < 0.1$, ** $p < 0.05$, *** $p <$
 171 0.01 .

172 4 Discussion

173 To my knowledge, this is the first quantitative study investigating referee bias in fencing
 174 tournaments. The large sample sizes for each weapon, combined with referees being randomly
 175 assigned to bouts, provided optimal conditions for detecting regional bias, if it existed. Despite the
 176 significant potential for fencing referees to influence bout outcomes due to their great discretionary
 177 power, my comprehensive dataset comprising 35,111 pool bouts over a seven-year period revealed
 178 limited evidence to support the hypothesis of regional bias. The linear and logistic regression models
 179 indicated a non-significant negative effect in foil and saber, while epee displayed a minimal positive
 180 effect that was significant only at the $p < 0.1$ level. This effect may be spurious considering the
 181 multiple testing across all three fencing weapons and should be interpreted with caution.

182 My results, utilizing score differential as an indicator of bias, differ from the study conducted
 183 by Hlasny and Kolaric (2015). Their research demonstrated a small but statistically significant
 184 regional bias using the differential in number of yellow cards as a measure. It is possible that there
 185 are unique aspects of fencing that make it less prone to regional bias. However, it is also plausible
 186 that a bias in assigning penalties exists in fencing but does not impact the final score. While penalties
 187 do play a role in foil and saber, referees must split their concentration between making right-of-way

188 calls and watching for penalties. In epee, the referee's full focus is on potential infractions. Perhaps
189 biased penalty judgments mostly result in yellow cards, which serve as warnings without impacting
190 the outcome. This could potentially explain the weakly significant result in epee and would also
191 suggest a potential compartmentalization in referee behavior: they may exhibit regional bias in
192 awarding penalties while maintaining impartiality in scoring decisions. Penalties often address
193 misconduct or rule violations, suggesting that referees might be more inclined to suspect infractions
194 from unfamiliar individuals while maintaining objectivity in other areas.

195 While my findings also contrast with Mills' (2013) scoring related results, which showed that
196 umpires make fewer strike calls against catchers, it is important to note that Mills' study examines
197 the umpire-catcher dynamic over the course of a single game, whereas referees have repeated, short-
198 term interactions with fencers from the same region. These varying interaction patterns may lead to
199 different relationships between referees and athletes. Nevertheless, the absence of evidence for
200 regional bias in scoring, although specific to fencing, offers broader insights on the numerous studies
201 on nationalistic bias in sports with subjective scoring (Emerson et al., 2009; Krumer et al., 2022;
202 Lyngstad et al., 2020; Zitzewitz, 2006) My findings suggest that nationalistic bias could be more
203 associated with conscious patriotic sentiments rather than unconscious preferences shaped by shared
204 regional identities, affiliations, or styles.

205 One limitation of my study was the lack of penalty data. Ideally, conducting an analysis of
206 penalties assigned during bouts could offer a nuanced perspective on referee behavior, providing an
207 alternative approach to assess partiality beyond the score, which can only indirectly measure the
208 impact of penalties. This would also allow a better evaluation of referee bias in epee, as most of the
209 subjectivity in this weapon arises from penalties. Moreover, it would enable a direct comparison of
210 my results with those of Hlasny and Kolaric's (2015). Unfortunately, penalty information is not
211 available on <https://usfencingresults.org>, limiting my investigation to the score differentials of the
212 bouts. Further studies could address this limitation by using videos of bouts or live observation to

213 determine the number of penalties issued, although this would likely result in a smaller sample size.
214 Another constraint is that I do not know the extent of referee's interactions with fencers in their
215 region. Future research could benefit from collecting data on the frequency and nature of these
216 interactions, potentially through surveys or by tracking referee assignments at regional events, to
217 better understand how different levels of familiarity might influence decision-making.

218 While this study finds limited evidence of regional bias in fencing, it cannot definitively rule
219 out the existence of other forms of bias. Firstly, referees may favor fencers from larger, well-known
220 clubs or high-seeded "favorites," as documented in other sports (Bose et al., 2021). Secondly, the
221 historical and current dominance of European fencers, representing over 50% of the combined top-10
222 FIE world ranking across all weapons in 2024 (Fédération Internationale d'Esgrime, 2024), raises
223 questions about potential biases. While this success could result from cultural factors or superior
224 coaching, it's important to consider possible implicit biases towards European styles or evolving
225 "right-of-way" rules potentially aligning better with their technique. Thirdly, people of color are
226 underrepresented in fencing. As of 2023, only 19.9% of USA Fencing's membership comprises
227 people of color, compared to the United States Olympic and Paralympic Committee's benchmark of
228 39.9% (USA Fencing, 2023). Since racial bias has been identified in other sports (Magistro & Wack,
229 2023), it may manifest in fencing. Fencing officiating bias remains understudied, and these areas
230 offer valuable avenues for future research.

231 **5 Conclusion**

232 In conclusion, this study explored the possibility of regional bias in fencing referees by analyzing
233 tournament data across all three weapons: foil, epee, and saber. Utilizing an extensive dataset of
234 35,111 pool bouts over seven years, I found limited evidence of regional bias at USA Fencing
235 national events, with nonsignificant effects in foil and saber and a minimal positive effect in epee.
236 These findings contrast with similar studies in other sports, suggesting that regular interactions

237 between referees and players do not necessarily result in biased officiating in fencing. The minimal
238 positive effect observed in epee suggests the need for further research into how decision-making
239 processes may differ between scoring and penalty calls. Additionally, my findings indicate the
240 importance of investigating how referees' relationships with players influence their judgments.

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