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Red shirt colour is associated with long-term team success in English football

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Abstract

The colour of sportswear has been shown to influence the outcome of bouts for several different combat sports. The generality of these effects, and whether they extend to collaborative forms of contests (team sports), is uncertain. Since 1947, English football teams wearing red shirts have been champions more often than expected on the basis of the proportion of clubs playing in red. To investigate whether this indicates an enhancement of long-term performance in red-wearing teams, we analysed the relative league positions of teams wearing different hues. Across all league divisions, red teams had the best home record, with significant differences in both percentage of maximum points achieved and mean position in the home league table. The effects were not due simply to a difference between teams playing in a colour and those playing in a predominantly white uniform, as the latter performed better than teams in yellow hues. No significant differences were found for performance in matches away from home, when teams commonly do not wear their "home" colours. A matched-pairs analysis of red and non-red wearing teams in eight English cities shows significantly better performance of red teams over a 55-year period. These effects on long-term success have consequences for colour selection in team sports, confirm that wearing red enhances performance in a variety of competitive contexts, and provide further impetus for studies of the mechanisms underlying these effects.

Keywords: *Soccer, coloration, colour, male dominance, performance, psychology*

Introduction

The use and impact of colour in sporting contests remains a relatively unexplored area of research. Hill and Barton (2005) showed that when red and blue uniforms were randomly assigned to contestants in bouts of Olympic boxing, taekwondo, freestyle wrestling, and Greco-Roman wrestling, the frequency of winners wearing red was significantly greater than expected by chance. Rowe and colleagues (Rowe, Harris, & Roberts, 2005) performed a similar analysis of judo bouts, finding that blue conferred an advantage over white. Possible mechanisms underlying these effects include psychological responses to colours, such as the perception that red is associated with dominance, and differences in visibility (Barton & Hill, 2005; Hill & Barton, 2005; Rowe *et al.*, 2005).

Hill and Barton (2005) proposed that enhanced winning rates of contestants wearing red might reflect an innate response to red as a signal of dominance. In a wide variety of animal species, red coloration is a sexually selected, testosterone-dependent signal of male quality (Dixson, 1998; Ligon, Thornhill, Zuk, & Johnson, 1990; Milinski & Bakker, 1990). Furthermore, the presence, size, and intensity of red displays has been found to correlate with dominance and resource-holding potential in males in both birds (Andersson, Pryke, Ornborg, Lawes, & Andersson, 2002; Pryke, Andersson, Lawes, & Piper, 2002; Pryke & Griffith, 2006) and primates (Dixson 1998; Dunbar, 1984; Setchell & Dixson, 2001; Setchell & Wickings, 2005). During aggressive interactions in both humans and non-human primates, skin redness intensifies in dominant individuals but decreases in frightened individuals, through changes in peripheral blood flow (Darwin, 1872; Drummond & Quah, 2001; Montoya, Campos, & Schandry, 2005). Cone cell sensitivities in the retina of trichromatic primates are optimized for discriminating variation in redness due to skin flushing or blanching (Changizi, Zhang, &

Shimojo, 2006). Responses to the colour red in contest situations can also be exploited by artificial stimuli. In zebra finches, the presence of red plastic rings increases the dominance rank of male birds (Cuthill, Hunt, Cleary, & Clark, 1997). Such sensory biases to artificial stimuli may thus also underlie the effects on contest outcomes in humans. Alternatively, colours may affect visibility of contestants and of team-mates, which in turn may affect performance (Rowe *et al.*, 2005).

Apart from the precise mechanisms underlying these effects, a number of other questions remain. One is whether they generalize to team sports. Hill and Barton (2005) presented provisional results on the role of shirt colour during an international football (soccer) competition ("Euro 2004", Portugal). All teams that wore red shirts in some of their matches and another colour in their other matches had better results in their red shirts. The sample size here was small (five teams), and it was not possible to investigate effects of other colour differences. Nevertheless, we hypothesize that, if the effect is general, it should be manifest in long-term patterns of results. We predict that teams wearing red will, on average, be more successful than teams wearing other colours. To address this hypothesis, we analysed team home performance relative to primary shirt colour among English football league teams since the Second World War.

Methods

We utilized extensive data available in on-line football archives (English Football Archive, 2006; Rivals Digital Media Ltd., 2006) to investigate the relative success of English teams since the 1946–47 season when the league resumed after the Second World War. Data were available up to 2001 and 2003 for the two databases respectively.

To determine whether red teams had been more successful within the Football League since the Second World War, we investigated the winning performance of each team in matches played at their home venue since 1946, expressed as percentage wins at home. Clubs wear their signature colours in home games, but change to an alternative in away games when there is a colour clash. Hence, the colours worn during away games are not consistent. To select teams for analysis, we used two *a priori* criteria:

1. Teams had to have spent most of the analysed post-war period of 56 seasons in the league since 1946–47 (i.e. played at least 29 seasons). The 90 teams satisfying this criterion were ranked in order of the percentage wins achieved at home over the period 1947–2003, with a

secondary rank by mean points per game (all data standardized as 3 points for a win).

2. Since the Second World War, there have been consistently 68 teams comprising the top three divisions of the Football League, so to assess success in the equivalent top three divisions we focused our analyses on the top 68 ranked clubs in the home league table (Table I, split into the equivalent three divisions). We hypothesized

Table I. Equivalent first three divisions in the English football league (with current number of teams in each division) if teams are ranked in order of percentage wins at home over the 1947–2003 period.

Rank	Team	Colour	% wins	Points/game
	Division 1			
1	Liverpool	R	64.8	2.16
2	Man Utd	R	61.2	2.07
3	Leeds	W	57.0	1.96
4	Arsenal	R	56.4	1.94
5	Reading	B	55.7	1.90
6	Ipswich	B	55.0	1.87
7	Newcastle	O	54.1	1.85
8	Southampton	R	53.8	1.86
9	Millwall	B	53.7	1.86
10	Blackburn	B	53.5	1.84
11	Tottenham	W	53.5	1.83
12	Wolves	Y	52.9	1.82
13	QPR	B	52.6	1.84
14	Bristol Rovers	B	52.4	1.84
15	Bristol City	R	52.1	1.82
15	Southend	B	52.1	1.82
17	Sheffield Utd	R	52.0	1.81
17	Aston Villa	O	52.0	1.81
19	Bournemouth	R	51.9	1.82
20	Middlesborough	R	51.9	1.81
	Division 2			
21	Everton	B	51.8	1.83
22	Gillingham	B	51.8	1.82
23	Man City	B	51.8	1.79
24	Peterborough	B	51.6	1.81
25	Burnley	O	51.6	1.80
25	Brighton	B	51.6	1.80
27	Derby	W	51.6	1.78
28	Bolton	W	51.4	1.79
29	Swansea	W	51.3	1.78
30	Swindon	R	51.2	1.80
30	Mansfield	Y	51.2	1.80
32	Preston NE	W	51.1	1.79
33	Chesterfield	B	51.0	1.78
34	Tranmere	W	51.0	1.77
35	Colchester	B	50.9	1.79
36	Notts Forest	R	50.9	1.78
37	Brentford	R	50.8	1.78
38	Wrexham	R	50.7	1.78
39	Plymouth	O	50.6	1.78
40	Northampton	O	50.6	1.76
41	Grimsby	O	50.5	1.77
41	Luton	W	50.5	1.77
43	Rotherham	R	50.4	1.77
44	Stoke	R	50.4	1.76

(*continued*)

Table I. (*Continued*).

Rank	Team	Colour	% wins	Points/game
		Division 3		
45	Sunderland	R	50.3	1.79
46	West Ham	O	50.3	1.76
47	Sheffield Weds	B	50.1	1.77
48	Stockport	B	50.0	1.76
49	Bradford City	Y	49.8	1.74
50	Carlisle	B	49.7	1.74
51	Port Vale	W	49.6	1.77
52	Barnsley	R	49.6	1.75
53	Notts County	O	49.5	1.74
53	Torquay	Y	49.5	1.74
55	Huddersfield	B	49.3	1.73
56	Norwich	Y	49.2	1.76
57	Bury	W	49.0	1.74
58	Oldham	B	49.0	1.73
59	Coventry	B	49.0	1.73
60	Hull	Y	48.9	1.74
61	Watford	Y	48.9	1.73
62	Chelsea	B	48.7	1.73
62	Cardiff	B	48.7	1.73
64	Blackpool	Y	48.6	1.72
65	Newport County	Y	48.6	1.70
66	Birmingham	B	48.5	1.72
67	Shrewsbury	O	48.3	1.72
68	Fulham	W	48.2	1.71

Note: Data provided for % wins, mean points per game (as 3 points for a win) and home shirt colour category (R = red; B = blue; W = white; Y = yellow or orange; O = other colours or combinations (see text)).

that if red teams have been more successful at home over time, there will be a concentration of red teams within these top echelons of the league.

The dominant home shirt colour for these 68 clubs over the time period was determined and categorized (using http://www.historicalkits.co.uk/index.htm). These were: red ($n = 16$), blue (23), all white (11), and yellow-orange (9). Where a shirt was mainly one colour plus some white, the team was categorized under the colour. The few mixes of more than one colour (e.g. red/blue) were placed in an "other" category, as were teams wearing shirts of a comparatively rare prime colour (e.g. green, black). Due to various colours making up this mixed group, these teams ($n = 9$) were not included in analyses. Inter-observer reliability was established in the following way. We provided 32 independent assessors with pictures of shirts of varying colours and asked them to place each in one of our categories. Of our four main colour categories, only one individual shirt was classed as an alternative colour by a single assessor (1 of 416, red classified as orange).

Differences in performance of teams wearing each defined shirt colour (red, blue, white, yellow-orange) were then formally tested using a Kruskal-Wallis

non-parametric test for differences between: mean rank in the "home" league, mean % wins obtained at home, and mean number of points per game at home. This analysis was repeated for these same teams on away form (when a range of different colours have been worn), creating a second league table on away performance alone. We hypothesized that there would be a weaker, or absent, effect of shirt colour for results away from home as a variety of colours are worn by teams. Success of a club, and choice of colour, may potentially be age-related, with older clubs being more successful or having "first choice" of the best shirt colour. To assess any confounding effect of age, we determined the year of entry into the Football League for each club. Club age was not significantly related to either shirt colour (Kruskal-Wallis test, $\chi^2 = 4.531$, d.f. = 3, $P = 0.210$) or home performance (Pearson's correlation with % wins: $r = -0.112$, $P = 0.365$, $n = 68$).

Within the top division (now the Premier League), the most successful red football teams tend to be associated with large English cities, so may have access to more resources in terms of fan base and financial support than teams situated in smaller cities or towns. To exclude this potential bias, which may explain the dominance of red teams as champions, we performed a matched-pairs analysis of performance from all English cities that provide supporters with a choice of more than one league team and where one of these teams plays in red shirts (Liverpool, Manchester, Nottingham, Bristol, Sheffield, Stoke, plus two separate regions of Greater London). For each pair of teams within a city, the final league position in each year from 1947 to 2001 (range of available fine-scale data) was determined. The football leagues were combined sequentially (where champion = 1) and the significance of the difference between the mean league positions of each pair of teams was calculated using a Wilcoxon signed ranks test.

Results

The proportion of league champions since 1947 indicates the expected trend: teams with red shirts winning substantially more often than expected on the basis of their frequency (Figure 1). Teams of other colours, in particular blue teams, have produced fewer champions than their representation within the league would suggest. It is possible, however, that these trends reflect the relative success of just a few red teams year after year, so analyses that treat each team as a single datum are required.

For the equivalent top three divisions, there were significant differences between teams wearing the four shirt colour categories in terms of their overall performance at home (Figure 2a: home league

rank, Kruskal-Wallis, $\chi^2 = 8.460$, d.f. $= 3$, $P = 0.037$; Figure 2b: percentage wins, Kruskal-Wallis, $\chi^2 = 8.406$, d.f. $= 3$, $P = 0.038$; Figure 2c: points per game, Kruskal-Wallis, $\chi^2 = 8.859$, d.f. $= 3$, $P = 0.031$). Red teams consistently showed the highest level of performance, while yellow-orange teams achieved the least success, particularly the mean ranking in the "home" league table (Figure 2a). Teams with
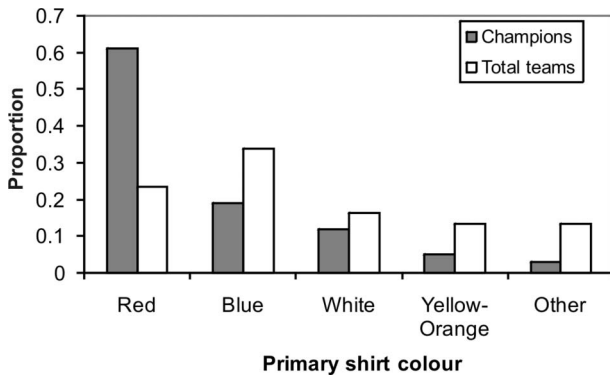
yellow-orange shirts were the only group consistently performing below teams with white shirts. There were no significant differences between teams of each shirt colour in terms of away performance (% wins, $\chi^2 = 1.052$, d.f. $= 3$, $P = 0.789$). Red teams were ranked lower in the "away" league than in the "home" league, while yellow-orange teams appear to have better overall results when playing away (Figure 2c). The overall distribution, however, is not significant due to the comparative similarity of blue and white teams' home and away form ($\chi^2 = 4.64$, d.f. $= 3$, $P > 0.10$).

In all but one city (Sheffield), the team playing in red has been more successful since 1946 than the other available team playing in a different colour (Figure 3). Overall, the red teams have a significantly better average league placing over this time period (Wilcoxon signed rank test: $Z = -2.313$, $P = 0.021$, $n = 8$). There was no significant difference in league joining dates between the two categories ($Z = -0.631$, $P = 0.528$).

Figure 1. Proportion of teams winning the English football league (1947–2003) within each shirt colour category, together with the proportion of shirt colours in the top ranked 68 football teams since 1946. Statistical analysis is not possible due to non-independence of data from year to year.

Discussion

We hypothesized that the use of a predominantly red uniform would enhance the long-term success of
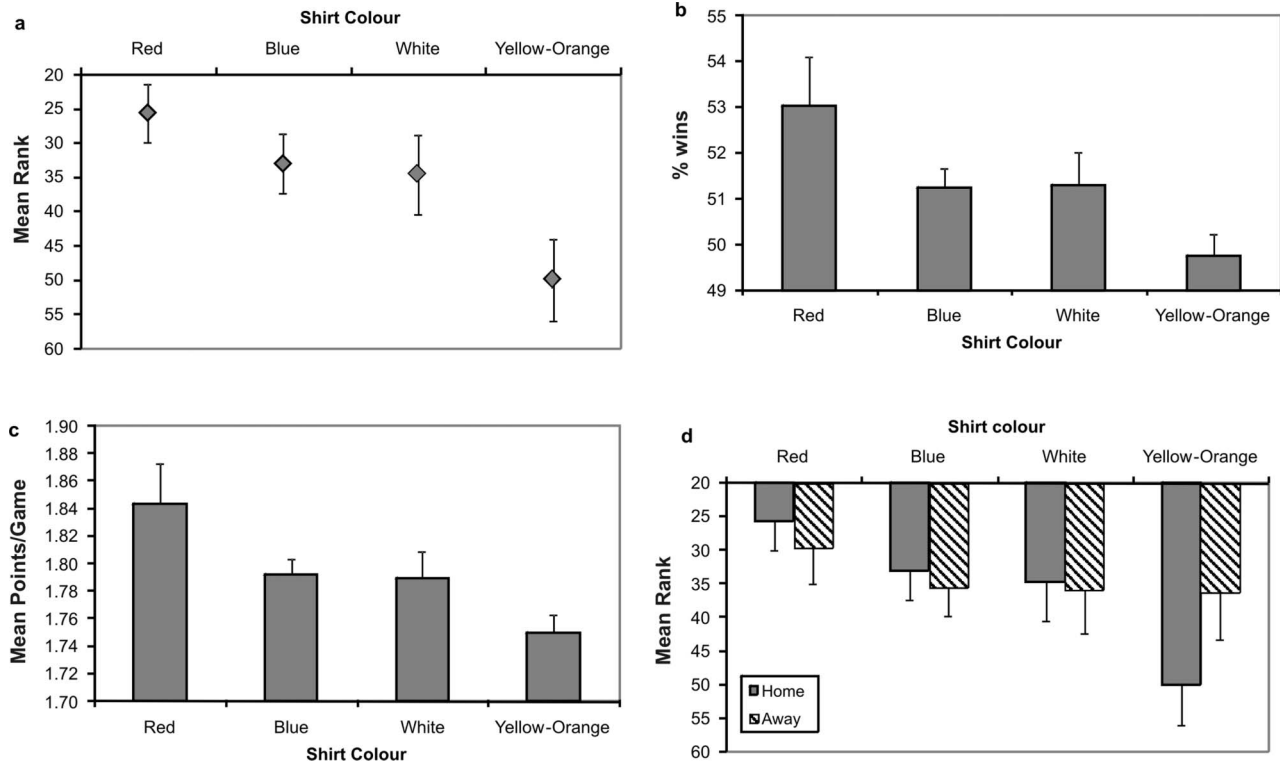

Figure 2. Performance of top ranked 68 football teams wearing each shirt colour at home from 1947 to 2003. (a) Mean league table position when home form only is considered (ranked by % wins). (b) Percentage wins obtained at home, presented as the mean % for each shirt colour. (c) Mean number of points per home game achieved by teams of each shirt colour (standardized as 3 points for a win across the whole period). (d) Comparative ranking for teams of each shirt colour within "home" and "away" % win league tables, demonstrating that red teams do not perform significantly better ($P = 0.789$) away from home when often wearing different shirt colours.
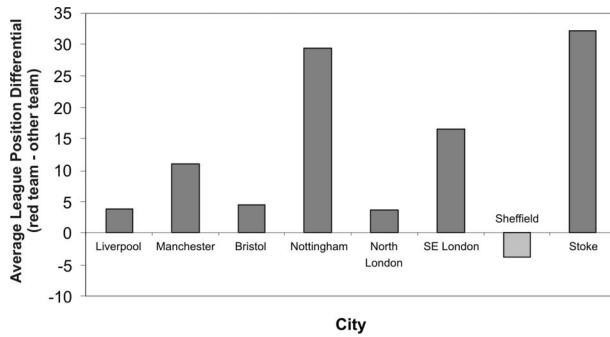
Figure 3. The difference in performance between teams from the same city where one of these teams wears red shirts as their home colour. The results are presented as the number of league places separating the two teams when mean league position since 1947 is calculated. This is expressed as the red team average position minus the average position of the other team within the city. Therefore, positive values show a higher average position for the red team.

football teams. Our findings support this hypothesis, and also show that it does not appear to be wearing a colour *per se* (relative to wearing white) that provides an advantage, as yellow- and orange-wearing teams performed particularly poorly. Hence, together with previous results (Hill & Barton, 2005), our findings suggest that the "red advantage" applies across a range of sports, circumstances, and competitor colours, perhaps rendering visibility differences (Rowe *et al.*, 2005) a less likely explanation than psychological and/or hormonal responses (Hill & Barton, 2005; Barton & Hill, 2005). Recent experimental work also bolsters the idea that the psychological impact of red affects performance (Elliot, Maier, Moller, Friedman, & Meinhardt, 2007). In the study of Elliot and colleagues, simply viewing red stimuli impaired performance, suggesting that one broad class of mechanism for the effects in sport is a psychological impact on opponents of red-wearing individuals or teams. More work is required to determine whether playing against red, wearing red or both affect performance.

Although visibility is unlikely to be the sole explanation for the effects reviewed above, we do not argue that it plays no role at all. In distinguishing the different types of effects, it will be important to use more sophisticated measurements of uniform and background colour. Colour is a function of three dimensions: hue (e.g. red, green), value (or lightness), and chroma (saturation), and each of these dimensions may have distinct perceptual or psychological effects. For example, the dominance signalling hypothesis predicts that hues closest to those produced naturally in the skin will have the strongest effects on performance, whereas the visibility hypothesis predicts that variables affecting colour-background contrast should be influential,

independently of intrinsic hue. With the current data set, we are unable to disambiguate the potential effects of the three colour dimensions, and believe that experimental manipulations will be necessary to do so.

Morris (1981) suggested that football team colours were tribal and symbolic, and that the conspicuous nature of red gave teams wearing that colour a psychological advantage, reflecting both the dominance signalling (Barton & Hill, 2005; Hill & Barton, 2005) and visibility (Rowe *et al.*, 2005) hypotheses. An additional factor in the long-term trends documented here may be that success breeds success, through the attraction of greater resources to winning clubs over time. Teams wearing red may be perceived as more attractive to paying supporters, due directly to their success and, perhaps, also indirectly due to the psychological association between success and red. This brings an enhanced resource base for successful red teams, so creating a positive feedback process reinforcing this success. However, this phenomenon may have changed recently, with a shift in the source of finances to major clubs from fans to individual benefactors. Thus, the injection of large sums of money into individual teams, irrespective of shirt colour, may begin to override any selective advantage that has built up over the last 50 years.

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