

Ethnic Differences in Achievement in Darts

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Data is presented on the ethnic composition of high level darts players. It is noted that the male players are overwhelmingly European and British and that British ethnic minorities are absent among top male darts players. It is shown that this is predicted by the dominant European body type. High level female darts players are slightly more ethnically diverse. This is predicted by race-based differences in sexual dimorphism. Though it is argued that culture plays a part in explaining these data, purely cultural explanations are shown not to be persuasive.

Key Words: Darts; Ethnicity; Football; Race; Somatotype; Snooker; Volleyball

There is considerable evidence for racial differences in success in a variety of sports, including short- and long-distance running, American football, baseball and swimming (Entine, 2000; Epstein, 2013; Irving and Charlton, 2010; Sailes, 1998). It has been argued that though culture plays a part in explaining these differences, these differences are significantly genetic because races tend to succeed in the sports which require the physical characteristics which different races possess (Epstein, 2013), sporting success is highly genetic (De Moor et al., 2007), and physical abilities, more broadly than sport, are also significantly genetic. For example, variation in lean body mass has been found to be 50% genetic (Arden and Spector, 1997) while forearm perimeter is around 68% genetic (Loos et al., 1997). This argument has been strengthened by evidence showing that racial differences in sporting ability exist at very young ages (Entine, 2000). An alternative argument has been that racial differences in success in different sports are attributable to sociological factors including racial discrimination, something which has been examined in relation to many sports (e.g. Carrington and McDonald, 2002; Joseph et al., 2012; Ross, 2005).

Hitherto, there has been no study examining the abilities required for success in darts, racial differences in success in darts, and the degree to which these may be attributable to genetic differences. This is the objective of the present study.¹ We will begin by establishing racial differences in body type and psychology as they relate to sport. We will then look at the specific abilities that predict darting success. Having established this, it will be shown that leading male darts players are overwhelmingly European, mainly British and that all of the British players are ethnically European. We will then discuss anomalies and sociological explanations and demonstrate that they can be explained in genetic terms or do not explain the data. Thus, we will argue that the most persuasive hypothesis is a partly-genetic one. Finally, we will examine the implications of the research and directions for future research.

1. Race Differences in Somatotypes and Other Characteristics

We will now examine racial differences in somatotype (body shape and composition) and other issues relevant to darting ability. Somatotypes are to a significant degree genetically determined, both at an individual and group level (Bouchard et al., 1997), and race differences in somatotype are present even in infants (Malina, 1969). The somatotypes are:

¹ I define race here, as in common usage, as a breeding population that genetically differs from other populations as a result of geographical isolation, cultural separation and endogamy, and which shows patterns of genotypic frequency for a number of inter-correlated characteristics compared with other breeding populations. A refutation of the criticisms of the race concept can be found in Lynn (2006, Ch. 1).

1. *Endomorph* (Fat). A rounded body shape (stocky, relatively short), characterized by relatively short limbs, large trunk, fat in the abdominal and lower body region, short neck, narrow shoulders, large chest, wide hips and poorly developed muscles but muscle strength is gained easily.
2. *Ectomorph* (Slim). Tall, thin, linear body, long extremities, short upper body, narrow chest and shoulders, very lightly muscled.
3. *Mesomorph* (Muscular). Large head, muscular chest, narrow waist, large shoulders, large heart, heavily muscled arms and legs, minimal body fat, short trunk and long limbs.

Somatotypes are described on a scale of 1 (low) to 7 (high). The principal racial body somatotype and other physiological characteristics relevant to sporting ability are now described.

1. *West Africans*. This is the most mesomorphic of the races, with long limbs, short torso, heavy skeleton, a well-muscled body and very little body fat. West Africans have around 75% fast twitch muscle fibers compared with around 25% in East Africans (Hochachka, 1998). This aids bursts of speed and power but has the effect that West Africans have low endurance. Blacks from the West Indies are principally of West African origin, with varying small amounts of European admixture (Epstein, 2013).

Both male and female West Africans have been found to have a more mesomorphic body type than have other races, when comparing with those of the same sex and based on representative samples. However, it has also been noted that women of West African descent (e.g. African Americans) suffer from particularly acute levels of obesity in food abundant environments. This is not the case, to the same extent, with men from this racial group. A proposed reason for this is that West African women have a particularly low metabolic rate compared to European women, meaning that they easily retain weight (see Berk, 2008, p. 233). West African men also have a lower metabolic rate than European men, but the difference is not as pronounced (Weyer et al., 1999). Moreover, a successful pregnancy requires energy stores in the form of fat (Prentice & Goldberg, 2000), meaning that the slower metabolism and larger fat stores of West African women compared to European women may imply that West African women are better adapted than European women for more frequent pregnancies.

2. *East Africans*. This is the most ectomorphic race with long limbs, low body fat, and lightly muscled. For example, Roberts and Bainbridge (1963) have shown that the Nilotic peoples have an average somatotype (endomorph-mesomorph-ectomorph) of 1.6-3.5-6.2, which makes them extreme ectomorphs. They also have around 75% slow-twitch fibers and a large lung capacity (Hochachka, 1998), which gives them very high endurance in long distance running. It should be emphasized that by 'East African' reference is being made to the areas dominated by Nilotic peoples.
3. *North East Asians*. These are the Chinese, Japanese and Koreans, the Mongoloids of classical anthropology. This race is the most endomorphic with short arms and legs, large trunk, and a high level of body fat, around 5% more than Europeans (Hu, 2008). They have relatively light skeletons (Weber, 2007, p. 543) and are the least muscular of the main races (e.g. Rushton, 2003, p. 178). Their slow and fast twitch muscle fiber distribution is about equal (Entine, 2000).
4. *Europeans*. This race is moderately endomorphic but less so than Northeast Asians and more so than West Africans and East Africans. There is also a strong upper body, broad shoulders, a longer and thicker trunk and shorter extremities, giving a lower center of gravity (Wagner & Heyward, 2000), and average lung capacity. Their slow and fast twitch muscle fiber distribution is about equal (Ama et al., 1986; Entine, 2000).
5. *South Asians*. This race is more ectomorphic, less mesomorphic and less endomorphic than Europeans (Berry and Deshmukh, 1964; Carter and Heath, 1990, p.171; Rangan, 1982; Singh, Sidhu and Malhotra, 1988). Compared with Northeast Asians, they are more muscular with longer limbs (Ming, 2012). Compared with Europeans, South Asians have a higher level of body fat (Lear et al., 2009), slightly longer limbs (Nightingale et al., 2010), a lighter bone structure (Ward et al.,

2007) and narrower waist. They are physically shorter even at young ages and controlling for socio-economic status, with a relatively low height-weight ratio (Nightingale et al., 2010).

In addition, research using a 'compilation' of adolescent samples has indicated that African Americans score three fifths of a standard deviation worse than European Americans on tests of fine motor skills (Grissmer and Eiseman, 2008, p. 155). Research has found indications for a significant genetic component to fine motor skills (e.g. Qian et al., 2013), implying that the racial difference may be genetic in origin or partly so. Also, as has been widely reported, there are consistent race differences in intelligence and personality, with Northeast Asians scoring an average IQ of 105, Europeans around 100, South Asians (in Western countries) around 90, and Sub-Saharan Africans (in Western countries) around 85 (Lynn, 2006). Races also vary in terms of modal personality with Northeast Asians being highest in neuroticism, conscientiousness and agreeableness and lowest in extraversion and openness, and Sub-Saharan Africans possessing the opposite profile (Rushton, 1997).

2. Factors Predicting Success in Darts

There is relatively little research on the factors which predict success in darts. However, according to Eastwood (2009, p. 633) darts players are more similar to strength athletes, such as weight lifters and rugby players, than they are to other kinds of athletes. This is because success in darts will, in part, be predicted by upper body strength, an element of endurance, and balance. A physically strong darts player will be more likely to be able to ensure that his dart sticks in the board or has sufficient momentum to land where he aims it rather than lower down the board. As such, we would expect successful darts players to be heavily European, though, as a degree of endomorphy is a benefit, there may be some representation from Northeast Asia as well. We would also expect darts players to be high in fine motor skills, or hand-eye coordination, as this would clearly benefit their throw (Hagger & Chatzisarantis, 2005, p. 140). It should be emphasized that the form of strength which Eastwood (2009) notes is necessary is upper body strength, rather than strength in general. It might be suggested that, intuitively, darts should simply or mainly be a test of fine motor skills. However, this would not explain why the build of darts players is comparable to rugby players (Eastwood, 2009, p. 633) nor would it explain why no female darts player is represented in the Professional Darts Corporation (see below). Thus, upper body strength as well as fine motor skills would appear to be important.

In addition, darts is a game of strategy, involving the making of quick mathematical calculations, and spatial intelligence. It also requires practice as with any sport, with low time preference predicted by higher intelligence and conscientiousness (Shamosh and Gray, 2008). Lynn (2011) has noted that chess, which is entirely a game of strategy, is very strongly predicted by intelligence. It is clear that the ability to win at chess involves successful strategizing, quick wits (as players are against the clock), and the ability to comprehend a high level of complexity. Frydman and Lynn (1992) investigated 33 tournament level chess players in Belgium aged between 8 and 13 and found an average IQ of 121, implying that IQ is an important aspect of chess success. Neubauer, Grabner and Stern (2006) reached similar conclusions based on an Austrian study. Many studies have also shown that athletes have above average levels of conscientiousness (e.g. Filho, Ribiero and Garcia, 2005; Fulkerson et al., 1999; Piedmont, Hill and Blanco, 1999; Shariati and Bakhtiari, 2011; Talyabee, Mogdam and Salimi, 2013).

On this basis, then, darts would be predicted by the correct combination of upper body strength, endurance, balance, flexibility, fine motor skills, intelligence (both mathematical and spatial) and conscientiousness. Darts players require mathematical intelligence in the sense that they must correctly make calculations very quickly in order to reach zero, on a double, in as few darts as possible. As such, we would predict that European representation in darts would be very high, there

might be some East Asian representation (due to high intelligence, especially mathematical and spatial),² but there would be very little South Asian or Sub-Saharan African representation.

3. Results

Until 1994, the British Darts Organization (BDO) was the main darting body. In 1994, due to various disagreements,³ a BDO contingent split off and formed a separate organization, the Professional Darts Corporation (PDC), which included all active previous BDO Championship winners. PDC is now widely understood to be the organization with superior darts players. All of its players are professionals, players tend to begin in the BDO and move on to the PDC, and the prize money is higher in the PDC. In the Grand Slam of Darts, the only event where BDO and PDC players can compete against each other, only one BDO player has ever won since 2007, when the event began (Bower, ND).

I conducted a visual analysis of the Top 110 ranked PDC darts players in January 2014. This is known as the PDC Order of Merit and is based on the amount of prize money a player has won over the preceding 2 years in assorted competitions such as the Ladbrokes World Darts Championship (Table 1). It should be emphasized that darts is played outside Europe and countries with predominantly European-origin populations. There are players from Hong Kong (Royden Lam) and one from Japan in the Top 100. Where a player is not from the majority ethnicity in his country, this is stated in the table. The PDC, unlike the BDO, does not operate a separate women's league. As such, the absence of women in the PDC simply implies that they have not reached the required standard. Table 1 lists the Top 30 players in the analysis.

Table 1. Top 30 PDC darts players (PDC Order of Merit) (2 January 2014, pdc.tv.com).

Rank	Name	Nationality
1	M. van Gerwen	Netherlands
2	P. Taylor	England
3	S. Whitlock	Australia
4	A. Lewis	England
5	D. Chisnall	England
6	J. Wade	England
7	P. Wright	England
8	W. Newton	England
9	R. Thornton	Scotland
10	R. van Barneveld	Netherlands
11	A. Hamilton	England
12	J. Pipe	England
13	K. Huybrechts	Belgium
14	B. Dolan	N. Ireland
15	M. King	England
16	I. White	England
17	R. Baxter	England
18	G. Anderson	Scotland
19	T. Jenkins	England

² It has been found that unlike Europeans, Northeast Asians have significantly higher spatial and mathematical than linguistic intelligence (Lynn, 2006).

³ Darts was extremely popular in the UK from around 1973 to the late 1980s, meaning that many darts players turned professional. Negative publicity, especially over the amount of alcohol players drank during televised games, led to it being gradually removed from television and thus a dramatic decline in sponsorship and dart player earnings. This culminated in a split, with the PDC going over to Sky TV (see Schemilt, 4 January 2013).

20	K. Painter	England
21	P. Nicholson	Australia
22	J. Caven	England
23	S. Beaton	England
24	C. Lloyd	England
25	M. Webster	England
26	A. Smith	England
27	R. Burnett	Wales
28	J. Part	Canada
29	V. van der Voort	Netherlands
30	M. Smith	England

All 30 of the players above are European and all but 7 are British. Of these British players, all are European. This means that white British people are over-represented, as they are 89% of the British population as of the 2011 census. When we extend the analysis to the top 110 players, 2 are non-European. We looked at the top 80 British players and found that, still, all were white. A chi-square test of statistical significance was conducted based on data from Britain's 2011 census. This over-representation was significant at $p = 0.0017$. It may be that cultural issues, such as the association between darts, the English working class and pubs (Crawford, 1999, p. 102), play some part in the over-representation of Europeans, but these results are as racial differences would predict independent of culture. Indeed, even ignoring the psychological aspect of darts, these results are as we would predict.

The results are replicated if we examine the darts championships. Between 1994 and 2014, the winner and runner-up in the PDC darts championship ($N = 42$) have only ever been European. However, one player, Phil Taylor, has won 14 times and come second 3 times. Over the same period in the BDO Championship, only 1 position has been occupied by a non-European. The Netherlands' Jelle Klaasen won in 2006. He is ethnically Indonesian. However, as noted, the standard in BDO darts is lower than in PDC.

4. Discussion

The results are as we would predict. All but 2 of the Top 110 PDC players are European as are the competition winners. It might be suggested that darts is a sport for the white working class, with its origins in public houses, and this explains the lack of black or South Asian players at a high level. This, along with their very small percentage of European populations where darts is popular, may explain the absence of East Asians, but it seems unlikely to be the entire explanation with regard to South Asians who are around 7% of the British population or blacks, who are 3%.⁴ The hypothesis advanced in this article is that the racial profile of darts is partly explained by genetic racial differences. It is certainly likely that culture plays a part in the profile because pubs, which are strongly associated with darts, are less likely to be attended by South Asians (especially Muslims) and darts can be regarded as part of white working class culture, which might thus exclude blacks. However, for the reasons we will now explore, it is unlikely that 'culture' is the sole explanation.

Firstly, such an explanation would dismiss the differences in body type noted as coincidence.

Secondly, soccer (known in England as 'football') is traditionally a working class sport and so, based on such an argument, there should be minimal black representation in English football. However, this is simply not the case. As of the 2012-2013 season, 32% (183 players) of the 568 Premier League footballers were black, whether British black or black foreign imports. 66.7% (479 players) were white (Harris, 2012). The percentage of blacks appears to be gradually increasing. In the previous season it was estimated at 25% non-white (overwhelmingly black) (Hattenstone, 2012), and in 2007 it was estimated that 12% were black, based on a study of 63% of the players (Kassimeris, 2007,

⁴ This is according to the 2011 census.

p.90). As such, blacks (mainly of West African origin) are heavily over-represented in top-flight English football, despite football being a sport of the white working class traditionally. This black over-representation is precisely as would be predicted by West African high mesomorphy. It is widely agreed that the average footballer body is endo-mesomorph (Erceg, Grgantov and Milic, 2013; Hazir, 2011; Salgado et al., 2009). Salgado et al. (2009) in a study of 187 Portuguese youth soccer players found an average somatotype of around 3.0-5.0-2.5. This would predict West African over-representation and this is precisely what we see. Interestingly, there are racial variations in position predicted by modal racial somatotype. Thus, 2 of the 20 premier league goal keepers in 2013-14 were part black (none were black). A number of studies have found that goalkeepers have the most endomorphic somatotype of all the players on the pitch (e.g. Erceg, Grgantov and Milic, 2013; Orhan, Sagir and Zorba, 2013; Salgado et al., 2009). Equally, Salgado et al. (2009) found that midfielders, even accounting for margin of error, tended to be the least mesomorphic and the highest in ectomorphy, a finding also noted by Hazir (2011). It would seem that the midfielder position involves the greatest endurance and we should find that blacks (at least of West African descent) are less over-represented in it. There is some evidence, based on a large sample, that this is the case. In the 1985-86 season in the four English divisions that then comprised top-flight football (N = 1445), blacks were 8% of fullbacks, 6% of center-backs, 5% of midfielders, and 14% of strikers. At the time, they composed around 1% of the UK population (Maguire, 1988, p. 262). Thus, the part-genetic argument explains all of the data, rendering it more parsimonious.

It might be argued that part of the explanation rests in the popularity of football relative to darts. However, darts is extremely popular in the UK. And, more importantly, UK blacks (generally of West African descent) are over-represented in relatively unpopular sports which one would predict, from their physical adaptations, they would be over-represented in. For example, the average somatotype of male high national level (A1 league) Italian volleyball players (N = 234) has been put at 2.1-4.1-3.3 (Gualdi-Russo & Zaccagni, 2001). Volleyball requires a combination of abilities but, in general, it can be said to be a fast paced game in which players benefit from the ability to move quickly and jump high in all positions. It is clear that the somatotype is relatively central. As such, we would not expect West Africans to dominate male volleyball but we would expect them to be over-represented, due to the relatively high mesomorphy and the importance of speed and leg strength. This can be observed through an examination of the English male volleyball top division, known as the Super 8s (Table 2).

Table 2. Volleyball players in the male Super 8s (January 2014) (Volleyballengland.org).

Team	Racial Composition
Team Northumbria	6 White, 1 Black
CBL London Polonia	18 White
Malory Eagles (London)	15 White, 2 Black
London Lynx	9 White, 2 Black, 1 Mixed (black/white), 3 Arab, 1 East Asian
Coventry and Warwick Riga	14 White
SGTV Solent 1	8 White
Sheffield Hallam	11 White, 3 Black
Wessex LeAF BU	9 White

In 2014 there were 90 white players, 8 black players, 3 Arabs, 1 mixed (black/white) and 1 East Asian playing in top flight English male volleyball. As such, of 103 players, 87% were white, roughly in line with the white percentage of the England population. 7% were black, over-representing blacks as they are 3.5% of the English population. This modest over-representation is as we predicted. Using a chi-square test, this was significant at $p < .02$.

Thirdly, sports which involve similar skills to darts reflect a similar ethnic profile. Olympic shooting (Table 3), for example, is dominated by Europeans and Northeast Asians. I have chosen to begin in 1992 as, due to doping, questions hang over many previous Olympic results, especially involving Eastern Bloc countries. Of the 18 medals awarded, 8 are to Northeast Asians and the rest are to Europeans. This is as we would predict.

Table 3. Male Olympic shooting medalists (50m pistol).

Year	Gold	Silver	Bronze
2012	South Korea	South Korea	China
2008	South Korea	China	Russia
2004	Russia	South Korea	North Korea
2000	Bulgaria	Belarus	Czech
1996	Russia	Belarus	Italy
1992	Belarus	China	Sweden

I am not aware of any research estimating the somatotype of archers. However, it is reasonable to suggest that they would be comparable to darts players and shooters. As such, we would expect Europeans to be well represented in Olympic archery. However, due to the importance of concentration and fine motor skills we would also expect representation from Northeast Asians. As with darts and shooting, we would expect very poor representation from sub-Saharan Africans. This can be discerned from an analysis of male Olympic medalists (Table 4).

Table 4. Male Olympic medalists in archery.

Year	Gold	Silver	Bronze
2012	South Korea	Japan	China
2008	Ukraine	South Korea	Russia (East Asian)
2004	Italy	Japan	Australia
2000	Australia	USA	Netherlands
1996	USA	Sweden	South Korea
1992	France	South Korea	USA

Of the 18 medals awarded, 10 are to Europeans and the remainder are to Northeast Asians. This is a similar result as was found with regard to Olympic shooting.

An examination of snooker shows a similar racial profile. Of the Top 30 international snooker players, according to the World Snooker Players Rankings, on 2nd January 2014, 28 were European and 2 were Northeast Asian (1 Chinese and 1 from Hong Kong) (Table 5).

Table 5. World snooker rankings, Top 30 (2nd January 2014) (worldsnooker.com).

Rank	Name	Nationality
1	M. Selby	UK
2	M. Williams	UK
3	J. Higgins	UK
4	D. Junhui	China

5	N. Robertson	Australia
6	S. Murphy	UK
7	A. Carter	UK
8	J. Trump	UK
9	S. Maguire	UK
10	G. Dott	UK
11	S. Bingham	UK
12	M. Allen	UK
13	R O'Sullivan	UK
14	M. Stevens	UK
15	S. Lee	UK
16	M. Gould	UK
17	M. Davis	UK
18	J. Cope	UK
19	S. Hendry	UK
20	A. Higginson	UK
21	P. Ebdon	UK
22	B. Hawkins	UK
23	M. Campbell	UK
24	R. Walden	UK
24	M. King	UK
26	D. Dale	UK
27	J. Perry	UK
28	R. Day	UK
29	M. Fu	Hong Kong
30	F. O'Brien	Ireland

All of the British players are white. If we extend this to the top 70, then all 51 of the British players are white, meaning whites are significantly over-represented at $p < .01$ based on a chi-square test. Hagger & Chatzisarantis (2005, p. 137) argue that snooker players benefit from similar skills to darts players: fine motor skills, upper body strength, flexibility and the ability to strategize. Abernethy, Neal and Koning (1994) also noted that better snooker players have superior mental recall (better memories) when compared to less successful players. These abilities would select in favor of Europeans and Northeast Asians, and this is precisely what we see. As such, the purely cultural argument is very unlikely as explanation for the racial profile of darts.

Another criticism of the argument that ethnic differences in darting performance are partly genetic is the different ethnic profile of female darts players. These play in a separate BDO Women's League. Their rankings, as of 23rd March 2014, are as follows:

Table 6. Female BDO rankings (23rd March 2014)

Rank	Name	Nationality
1	Deta Hedman	England (Jamaican)
2	A. Dombrowslova	Russia
3	Rachel Brooks	England
4	Fallon Sherlock	England
5	Trina Gulliver	England
6	Aileen de Graaf	Netherlands
7	Julie Gore	Wales

8	Irina Armstrong	Germany
9	Zoe Jones	England
10	Lia Ashton	England
11	Sharon Prins	Netherlands
12	Lorraine Winstanley	England
13	Rachna David	Norway (South Asian)
14	Paul Jacklin	England
15	Sue Gulliver	England
16	Anneke Kuijten	Netherlands
17	Tricia Wright	England
18	Tamara Schuur	Netherlands
19	Dee Bateman	England
20	Floortje van Zanten	Netherlands

It can be seen from Table 6 that of the Top 20 the number 1 is of West African origin while the number 13 is of South Asian origin. However, this (still relatively small) difference can be explained in genetic terms. Genetic bodily differences between men and woman are not uniform across all races. Wells (2012) drew upon anthropometric data on 96 non-industrialized populations across the world. He found that: 'The magnitude of dimorphism was not randomly distributed across global regions.' It was 'lowest in African and Asian populations and greatest in Arctic populations. There was a negative correlation across populations between lean mass dimorphism and adiposity dimorphism, independent of temperature. With decreasing temperature, dimorphism in both lean mass and adiposity increased. Dimorphism increased in fatter but not taller populations, independently of temperature.' This means that European women are more physically different from European men than African women are from African men or Asian women from Asian men. As such, Wells' (2012) data would neatly explain the slight difference in ethnic profile between leading male and female darts players. An analysis by Dutton and Stretch (2014) found that this same factor explained sex differences in the racial profile of Olympic track and field medalists.

5. Conclusion

An analysis of high level darts acts as further evidence that racial differences in sporting achievement are partly genetic in origin. Cultural determinist explanations are unable to explain all of the available data, whereas a partly genetic explanation can do so. Darts is overwhelmingly European not only because the game originated in Europe, but also because the European body involves the correct balance of upper body strength, balance, flexibility and fine motor skills. European darting achievement is also aided by intelligence and certain personality characteristics. In terms of future research, we have noted evidence of racial differences in fine motor skills, with fine motor skills obviously being important to darts and the similar sports we have examined. It would be useful to examine racial differences in fine motor skills with a larger racial sample than simply blacks and whites in the USA. Future research should test the relationship between fine motor skills and cognitive abilities, particularly intelligence. It may be that, as with reaction times, the two are positively correlated and this would help to explain the racial profile of darts and other sports which test fine motor skills.

References

- Abernethy, B., Neal, R. & Koning, P. (1994). Visual-perceptual and cognitive differences between expert, intermediate, and novice snooker players. *Applied Cognitive Psychology* 8: 185-211.
- Ama, P., Simoneau, J., Boulay, M. et al. (1986). Skeletal muscle characteristics in sedentary black and Caucasian males. *Journal of Applied Physiology* 61: 1758-1761.

- Arden, N. & Spector, T. (1997). Genetic influences on muscle strength, lean body mass, and bone mineral density: A twin study. *Journal of Bone Mineral Research* 12: 2076-2081.
- Berk, E. (2008). Ethnic Disparities in Obesity among women. In: K. Keller (ed.), *Encyclopedia of Obesity*. London: Sage.
- Berry, J. & Deshmukh, P. (1964). Somatotype of male college students in Nagpur, India. *Human Biology* 36: 157-176.
- Bouchard, C., Malina, R. & Perusse, L. (1997). *Genetics of Fitness and Physical Performance*. Champaign, IL: Human Kinetics.
- Bower, A. (ND). Darts' Infamous Split: The PDC is Born.
<http://darts.about.com/od/DartsHistory/a/Darts-Infamous-Split-Part-Two-The-Pdc-Is-Born.htm>
- Carrington, B. & McDonald, I. (eds.) (2002). *'Race,' Sport and British Society*. London: Routledge.
- Carter, J. & Heath, B. (1990). *Somatotyping: Development and Applications*. Cambridge: Cambridge University Press.
- Crawford, S. (1999). Darts. In: D. Levenson & K. Christensen (eds.), *Encyclopedia of World Sport: From Ancient Times to the Present*. Oxford: Oxford University Press.
- De Moor, M., Spector, T., Cherkas, L. et al. (2007). Genome-wide linkage scan for athlete status in 700 British female DZ twin pairs. *Twin Research and Human Genetics* 10: 812-820.
- Dutton, E. & Stretch, R. (2014). Racial differences in sexual dimorphism as an explanation for differences in Olympic track and field achievement. *Mankind Quarterly* 55: 52-73.
- Eastwood, M. (2009). *Principles of Human Nutrition*. Hoboken, NJ: John Wiley & Sons.
- Entine, J. (2000). *Taboo: Why Black Athletes Dominate Sports and Why We're Afraid to Talk about It*. New York: Bantam Press.
- Epstein, D. (2013). *The Sports Gene: What Makes the Perfect Athlete*. New York: Random House.
- Erceg, M., Grgantov, Z. & Milic, M. (2013). Somatotype of Croatian amateur soccer players — positional differences. *Indian Journal of Applied Research* 3: 11.
- Filho, M., Ribiero, L. & Garcia, F. (2005). Comparison of personality characteristics between high level Brazilian athletes and non-athletes. *Revista Brasileira de Medicina de Esporte* 11: 114-118.
- Frydman, M. and Lynn, R. (1992). The general intelligence and spatial abilities of gifted young Belgian chess players. *British Journal of Psychology* 35: 233-235.
- Fulkerson, J., Keel, P., Leon, G. & Dorr, T. (1999). Eating-disordered behaviors and personality characteristics of high school athletes and non-athletes. *International Journal of Eating Disorders* 26: 73-79.
- Grissmer, D. & Eiseman, E. (2008). Can gaps in the quality of early environments and non-cognitive skills help explain persisting black-white achievement gaps? In: K. Magnuson & J. Waldfogel (eds.), *Study Gains and Stalled Progress: Inequality and the Black-White Test Score Gap*. New York: Russell Sage Foundation.
- Gualdi-Russo, E. & Zaccagni, L. (2001). Somatotype, role, and performance in elite volleyball players. *Journal of Sports Medicine and Physical Fitness* 41: 256-262.
- Hagger, M. & Chatzisarantis, N. (2005). *Social Psychology of Exercise and Sport*. Maidenhead: McGraw-Hill International.

- Harris, N. (20 August 2012). Premier league diversity at the heart of global appeal. *Sporting Intelligence*. <http://www.sportingintelligence.com/2012/08/20/premier-league-diversity-at-heart-of-global-appeal-200801/>
- Hattenstone, R. (13 July 2012). Racism in football: Putting the boot in. *The Guardian*.
- Hazir, T. (2011). Physical characteristics and somatotype of soccer players according to playing level and position. *Journal of Human Kinetics* 26: 83-95.
- Hochachka, P. (1998). Mechanism and evolution of hypoxia tolerance in humans. *Journal of Experimental Biology* 201: 1243-1254.
- Hu, F. (2008). Metabolic consequences of obesity. In: F. Hu (ed.), *Obesity Epidemiology*. Oxford: Oxford University Press.
- Irving, R. & Charlton, V. (eds.) (2010). *Jamaican Gold: Jamaican Sprinters*. Kingston: University of the West Indies Press.
- Joseph, J. (2006). *The Missing Gene: Psychiatry, Heredity, and the Fruitless Search for Genes*. New York: Algora Publishing.
- Joseph, J., Darnell, S. & Nakamura, Y. (eds.) (2012). *Race and Sport in Canada: Intersecting Equalities*. Toronto: Canadian Scholars Press.
- Kassimeris, K. (2007). *European Football in Black and White: Tackling Racism in Football*. Lanham, MD: Lexington Books.
- Lear, S., Kohli, S., Bondy, G. et al. (2009). Ethnic variation in fat and lean body mass and the association with insulin resistance. *Journal of Clinical Endocrinology and Metabolism* 94: 4696-4702.
- Loos, R., Thomis, M., Maes, H. et al. (1997). Gender-specific regional changes in genetic structure of muscularity in early adolescence. *Journal of Applied Physiology* 82: 1802-1810.
- Lundahl, M., McCarthy, C. & Petersson, L. (2003). *In the Shadow of South Africa: Lesotho's Economic Future*. Aldershot, Hants: Ashgate.
- Lynn, R. (2006). *Race Differences in Intelligence: An Evolutionary Analysis*. Atlanta, GA: Washington Summit Publishers.
- Lynn, R. (2011). *The Chosen People: A Study of Jewish Intelligence*. Augusta, GA: Washington Summit Publishers.
- Maguire, J. (1988). Race and position assignment in English soccer: A preliminary analysis of ethnicity in sport in Britain. *Sociology of Sport* 5: 257-269.
- Malina, R. (1969). Growth and physical performance of American negro and European children. *Clinical Pediatrics* 8: 476-483.
- Ming, X. (2012). Comparison of somatotypes of 29 ethnic groups in China. *Acta Anatomica Sinica* 43: 130-134.
- Neubauer, A., Grabner, R.H. & Stern, W. (2006). How much *g* is needed to play chess successfully? Proceedings of the 7th Annual Conference of the International Society for Intelligence Research.
- Nightingale, C., Rudnicka, A., Owen, C. et al. (2010). Patterns of body size and adiposity among UK children of South Asian, black African-Caribbean and European origin: Child Heart and Health Study in England (CHASE Study). *International Journal of Epidemiology* 40: 33-44.
- Orhan, O., Sagir, M. & Zorba, E. (2013). Comparison of somatotype values of football players in two professional league football teams according to positions. *Collegium Anthropologicum* 2: 401-405.

- Piedmont, R., Hill, D. & Blanco, S. (1999). Predicting athletic performance using the five factor model of personality. *Personality and Individual Differences* 27: 769-777.
- Prentice, A. & Goldberg, G. (2000). Energy adaptations in human pregnancy: Limits and long term consequences. *American Journal of Clinical Nutrition* 71: 1226-1232
- Qian, Y., Chen, M., Forssberg, H. & Diaz Heijtz (2013). Genetic variation in dopamine-related gene expression influences motor skill learning in mice. *Genes, Brain & Behavior* 12: 604-614.
- Rangan, S. (1982). *Validity of Age, Socioeconomic Belonging and Dietary Type as Somatotype Determinants in Boys of Secondary Schools*. PhD Thesis: Bangalore University.
- Roberts, D. & Bainbridge, D. (1963). Nilotic physique. *Journal of Physical Anthropology* 21: 341-370.
- Ross, C. (2005). *Race and Sport: The Struggle for Equality On and Off the Field*. Oxford, MI: University of Mississippi Press.
- Rushton, J.-P. (1997). *Race and Evolution: A Life History Perspective*. New Brunswick, NJ: Transaction.
- Rushton, J.-P. (2003). Race differences in *g* and the Jensen effect. In: H. Nyborg (ed.), *The Scientific Study of General Intelligence: A Tribute to Arthur R. Jensen*. Amsterdam: Pergamon.
- Sailes, G. (ed.) (1998). *African Americans in Sport*. New Brunswick, NJ: Transaction Publishers.
- Salgado, B., Vidal, S., Silva, S. et al. (2009). Somatotype and body composition in Portuguese youth soccer players. In: B. Drust et al. (eds.): *International Research in Science and Soccer. Proceedings of the first World Conference on Science and Soccer*. New York: Routledge.
- Schemilt, S. (4 January 2013). BDO World Championship: 20 years on, will darts ever be united? *BBC Sport*. <http://www.bbc.com/sport/0/darts/20903601>
- Shamosh, N. & Gray, J. (2008). Delay discounting and intelligence: A meta-analysis. *Intelligence* 36: 289-305.
- Shariati, M. & Bahktiari, S. (2011). Comparison of personality characteristics of athlete and non-athlete students, Islamic Azad University of Ahvaz. *Procedia - Social and Behavioral Sciences* 30: 2312-2315.
- Singh, S., Sidhu, L. & Malhotra, P. (1988). Body measurements and somatotypes of young adult Jat-Sikh men of Punjab, India. *Anthropologischer Anzeiger* 46: 261-267.
- Talyabee, S., Moghdam, R. & Salimi, M. (2013). The investigation of personality characteristics in athlete and non-athlete students. *European Journal of Experimental Biology* 3: 254-256.
- Wagner, D. & Heyward, V. (2000). Measures of body composition in blacks and whites: A comparative review. *American Journal of Clinical Nutrition* 71: 1392-1402.
- Ward, K., Roy, D., Pye, S. et al. (2007). Forearm bone geometry and bone mineral content in women of European and South Asian origin. *Bone* 41: 117-121.
- Weber, J. (2007). *Nurses' Handbook of Health Assessment*. New York: Lippincott, Williams & Wilkins.
- Wells, J. (2012). Sexual dimorphism in body composition across human populations: Associations with climate and proxies for short- and long-term energy supply. *American Journal of Human Biology* 24: 411-419.
- Weyer, C., Snitker, S., Bogardus, C. & Ravussin, E. (1999). Energy metabolism in African Americans. Potential risks for obesity. *American Journal of Clinical Nutrition* 70: 13-20.