

The difference between left and right feet

ZACH ARMITAGE investigates the challenges faced by shoemakers endeavouring to provide a range of footwear to fit the target population.



Most people's left foot is a different size from their right

When considering feet, it is not immediately obvious to think of them as different, in the same way that our left hand may often not be considered as being noticeably different to our right. However, the simple distinction of right and left is a major distinguishing feature between the two. For hundreds of years, footwear was produced with no distinction between the left and right shoe. These 'straights' (figure 1)

persisted up until the 1800s, with a notable historical reference referring to how shoes should be 'worn one day on the left and the next on the right, to wear them off evenly'. A number of great thinkers wrestled with the difference between left and right. However, while they appear the same, they are not. One is a virtual mirror image of the other and so is a very similar, but reversed shape. When given a left or right hand,

we are unequivocally able to distinguish one from the other.

With regard to 'straights', there are many preserved examples of distinct left and right footwear and thousands of archaeological and historical records that demonstrate the fact that shoemakers have known and accounted for the difference between left and right feet for thousands of years. Straights became common in the

17th century and were a result of using one last to produce both shoes of a pair. The demand of goods increased as the European population grew in the 16th and 17th century, and the machinery available at the time to cater for this demand favoured the symmetrical shape of producing straight lasts for this growing mass market. In the early 18th century, innovations in lathes for gun stocks provided the machinery and skill to turn distinct left and right lasts cheaply for mass production.

This most prominent difference between left and right – the fact that one is the virtual mirror image of the other – is still underemphasised. To this day, we still produce footwear that does not distinguish sufficiently enough between left and right. This is particularly noticeable in women's fashion footwear, such as peep toes which tend to head toward a central point, in which the big toe is pushed towards the centre of the foot to give a more symmetrical look. Unnecessary deformation of the foot may be caused, leading to hallux valgus, bunions and other ailments.

Most people have different sized feet

The symmetry of our limbs is not perfect, and a number of differences can be measured between the left and right side. It is relatively rare that the length of the right and left foot is identical, and this holds true for any measurement around the foot. Typically, only around 1 per cent of the global population have identical foot length on both right and left feet (to the nearest 0.1mm), and the probability of identical measurements drops drastically when accounting for further measurements. The foot changes shape throughout the day, depending on the person's level of activity. Therefore, even when identical feet exist, they may only be exactly the same for a short period of time each day.

It is far more likely that minor differences will be seen between the left and right foot. Taking the UK population as an example, figure 2 shows the percentage of the population with different foot lengths. As is expected, there are very few cases of identical length, while a small difference is common and larger differences becoming progressively less common.



Figure 1: 'straight' lasts – with no difference between the left and the right foot – were used until the 1800s

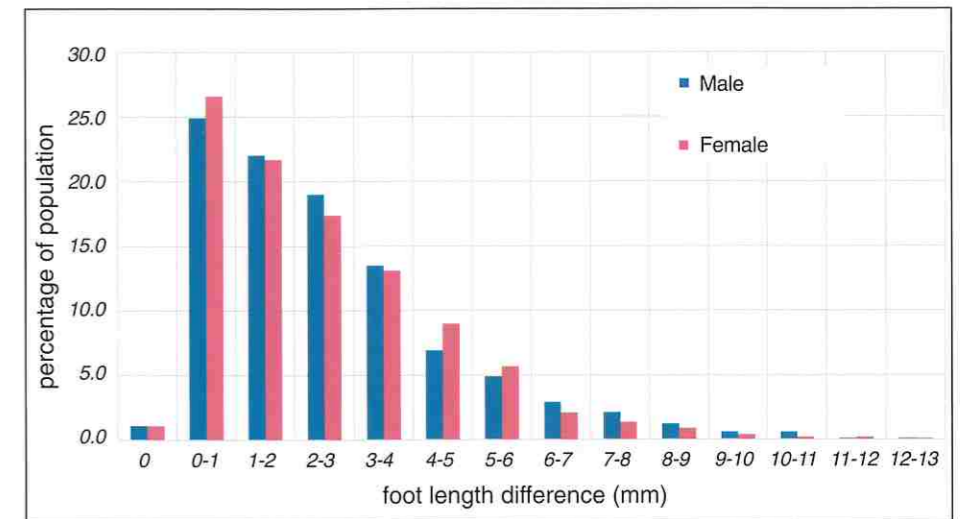


Figure 2: Percentage of the UK population with a difference in foot length in mm

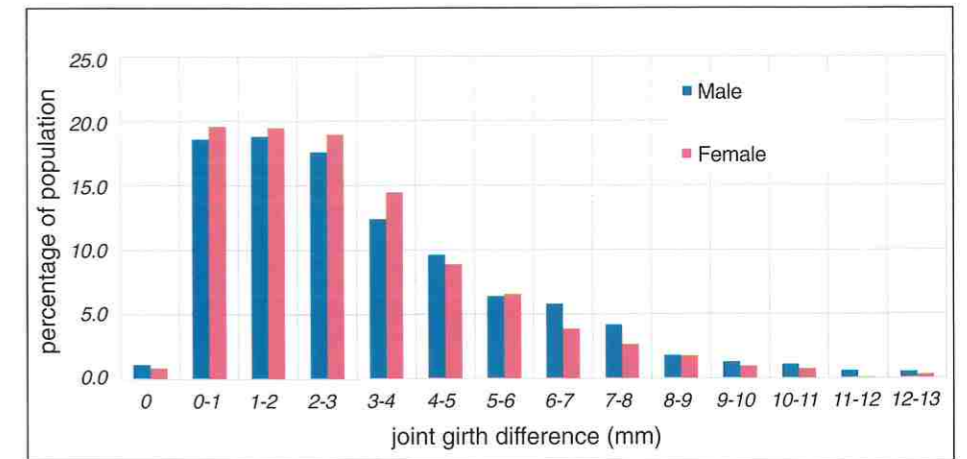


Figure 3: Percentage of the UK population with a difference in joint girth in mm



More than 80 per cent of the world's population are right footed, meaning that the right shoe will be used more than the left in kicking sports

As many as 19 per cent of people in the UK have a difference in foot length greater than 4mm (approximately half a UK size), and around 2 per cent of them have a difference of 8mm or greater – approximately one whole UK size. A similar trend is seen in the USA, and in China no less than 24 per cent of people have a difference greater than 4mm.

Other factors involved

Length is not the only factor that contributes to fit. There is a strong argument that joint girth and foot breadth play an equally strong, if not stronger, role in footwear fit. Again, it is unlikely that the joint girth on one side is exactly equal to the other. The percentage of global population in which this occurs is approximately 1 per cent. With joint girth, however, it is more common to see larger differences between the feet than for foot length (figure 3). Some 31 per cent of UK men have a difference in joint girth of greater than 4mm, rather than the 19 per cent having differences in foot length of the same amount. To give context against fitting to these values, 15.3 per cent of UK men and 10.6 per cent of UK women have a difference in joint girth of greater than 6mm (approximately one UK width fitting). Very similar values are seen for the USA and Chinese demographics.

The difference in measurements between the left and right feet follows

very closely to a normal distribution curve, as would be expected, with a slight skew due to the right foot tending to be the longer. Within the UK's female population, 50.7 per cent have the right foot longer than the left, and this figure rises to 54.8 per cent for UK men.

With such a small difference, it is reasonable to state that there is no trend for one foot to be generally longer than the other in the UK. Data for feet in the USA suggests a similar percentage. However, an interesting statistic occurs within the Chinese population, in which 61.7 per cent of women and 66.6 per cent of men have the right foot longer than the left. This statistic does not appear in any other foot measurement in the three global demographics and, as yet, there is no explanation for this unusual result. The right foot only tends to be longer than the left by a small amount on average, so it is unlikely to affect fitting.

By conducting the same analysis on joint girth, it is seen that the left foot typically has more volume than the right foot in all six demographics (male or female in UK, USA, China).

Approximately 10 per cent more of the global population have greater volume in their left foot, with a percentage a little higher for women than for men. Given that it is (slightly) more likely for the right foot to be longer and there is a noticeable trend for the

left foot to be broader, is there a distinct likelihood for the longer foot to have less volume than the shorter foot? By assessing each foot for both length and joint girth, and observing the instances for each of the four cases – i) left is both longer and broader, ii) right is both longer and broader, iii) left is longer and narrower, and iv) right is longer and narrower – it was found that there was a fairly even split. There is no particular trend between feet, and the most important conclusion to take from this study is the spread of differences between feet shown in figures 2 and 3.

There is one final, prominent difference between the left and the right foot that could warrant distinct design choices between the left and right shoe. Handedness (or 'footedness' when considering feet) is the dominance of one side over the other, and is commonly observed in hands, feet and eyes. Globally, around 10 per cent of people are left-handed, so it makes sense to design tools (such as scissors) with this in mind. Being left footed is marginally more common (at 18 per cent), but this still leaves a distinct trend for right footedness. In kicking sports, this means the right shoe will be used more often than the left. Even in standard footwear, it is likely that the right will wear faster than the left as the wearer generally steps first with the dominant foot, leading to more steps being taken on that side.

The difficulties of fitting are exacerbated by the potential differences in size and shape between feet. With an individual's feet able to differ by half or even a whole width fitting or shoe size, the benefits of half sizing and multiple width fittings become apparent. While we are unlikely to provide different left and right sizes for individuals, a greater range of choice in sizing and fitting will help to accommodate the ranges of foot shape in a population and offer more options to those that do have a difference between left and right.

Please email research@satra.com for further information on the difference in size between the typical left and right foot.