Shapes and Their Coefficients of Friction

作成者：★Ria★

What shapes

Shoe soles are mostly made a rubber with great slip resistance: thermoplastic rubber (TPR) . However, little is known about the correlation between the pattern or shape of the surface in contact and its friction force. Thus I measured the static friction as well as the kinetic friction of shapes often observed in shoe sole patterns to compare their slip resistance in terms of their coefficients of friction (COF).

Background Research

I surveyed ten random shoe soles, and counted the number of shapes observed in each shoe sole pattern. (Fig 1)

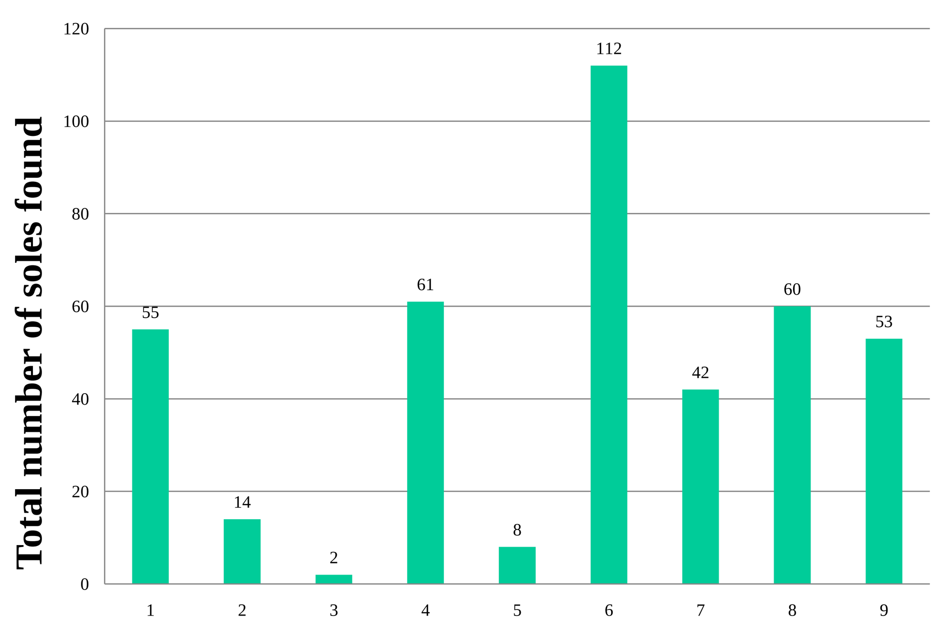

Fig.1 (a) Total number of shapes observed in ten random shoe soles. Numbers 1-9 correspond to the shape found: rectangle, cross hexagon, trapezoid, semicircle, lines, triangle, circle, and square, respectively **(b)-(f)** Some of the soles surveyed

Method

•Rubber soles were attached to a kitchen scale with string, and pulled horizontally on the ground. [Fig.2]

•Weights were placed on top of each rubber sole to amplify the friction force

•An otherwise identical experiment was conducted with the floor wet.

•Five trials were performed with all possible combinations of distinctive shapes and wet or dry floor.

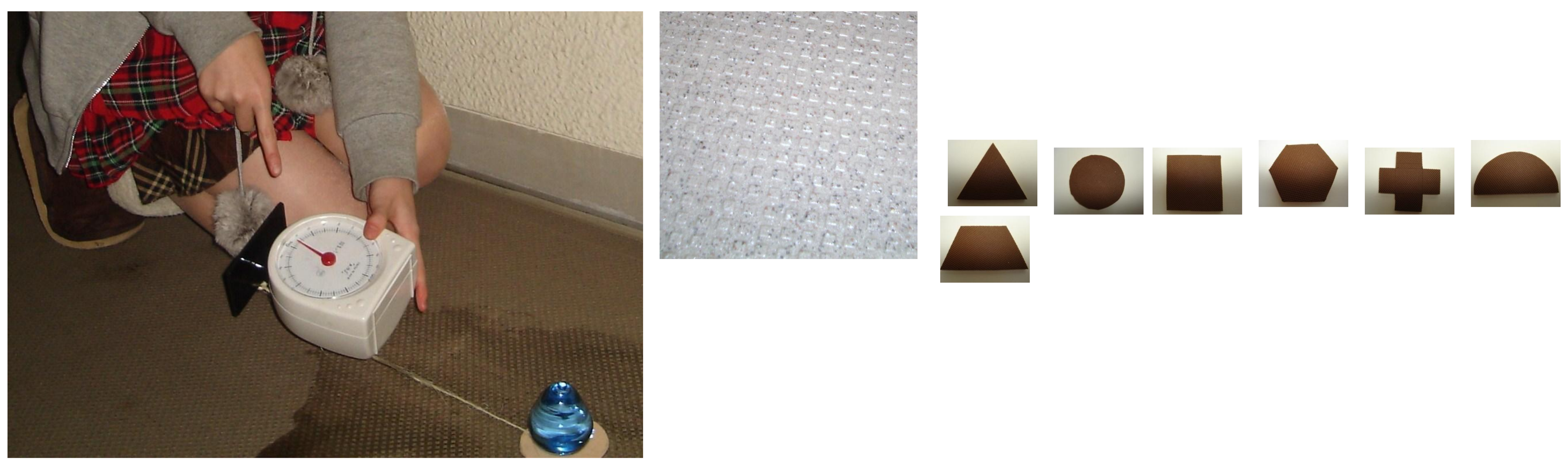

Fig. 2 (a) Square shaped rubber sole pulled by kitchen scale (c) Distinctively shaped rubber shoe soles used to measure coefficients of friction. (Left to right) triangle, circle, square, hexagon, cross, semicircle, trapezoid.

Shapes that have exhibit greater friction tend to be used more frequently in shoe sole patters

The coefficient of static friction varied more with different shapes, than did the coefficient of kinetic friction. [Fig.3] Compared with the number of shapes observed in shoe sole patterns in my survey, the results show that shapes that have greater static friction tend to be used more frequently in shoe sole patterns, though there are exceptions such as the hexagon and the square. Both COFs decreased when the floor was wet; this confirms the lack of traction between shoe soles and the floor due to rain.

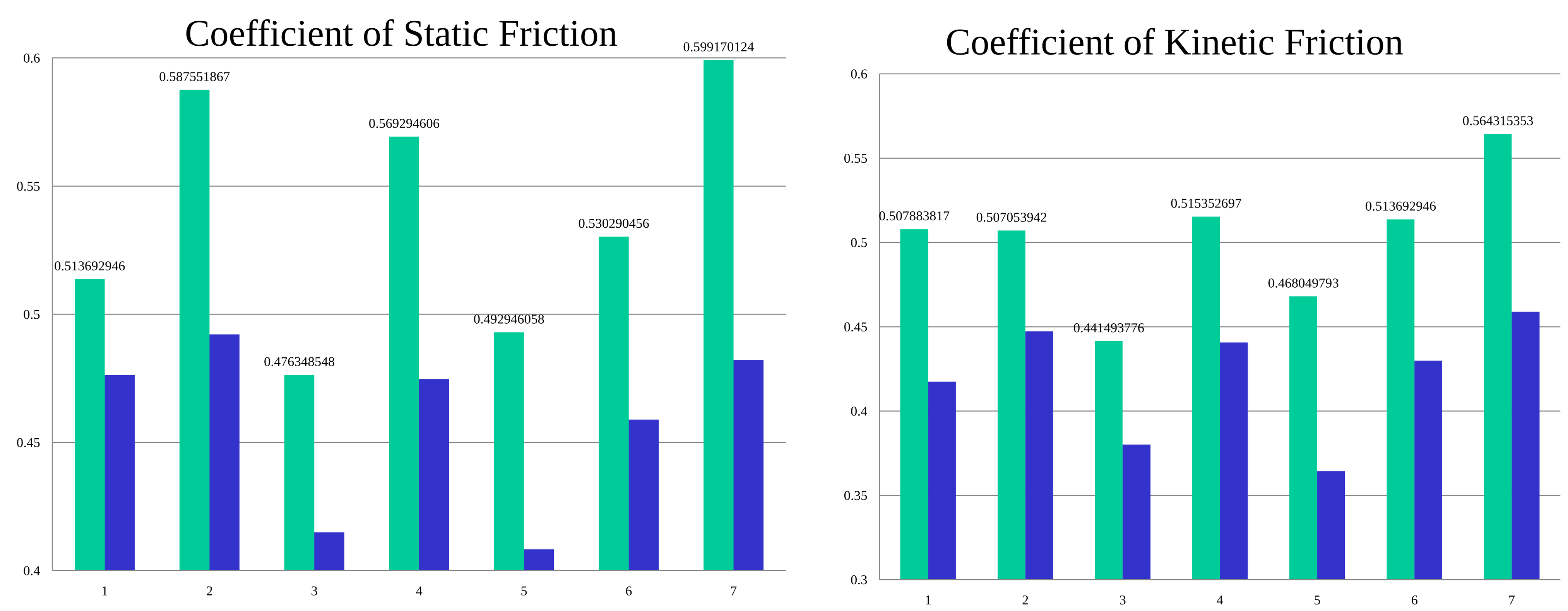

Fig. 3 Coefficient of friction measured for dry floor (blue) and wet floor (red). Vertical axis: average coefficient measured for five trials. Horizontal axis: shape tested. Numbers 1-7 correspond to the shape triangle, circle, square, hexagon, cross, semicircle, triangle, respectively.

Spatial orientation is also considered in shoe sole production

In the production of shoes, the shapes on shoe soles patterns are likely to be determined not only by the size of friction force resulting from particular shapes in contact with the ground, but also by the easiness of spatial orientation of the shape itself.

Applications of the regulation of shape configurations

These results suggest that regulating the configuration of shapes may open a new door to controlling the friction force between two surfaces, aside from the popular way of modifying the material itself. Regulation of friction force by arranging shapes in their most expedient configuration may have applications in manufacturing more effective precision instruments and engines.

References

Resource Library: Shoe Sole Materials:
<http://www.large-size-shoes-for-men.com/shoe_soles.html>