

Evaluation of the Random Nature of Acquired Marks on Footwear Outsoles



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Introduction

- NAS Report:
 - “... the committee is not aware of any data about the **variability of class or individual characteristics** or about the validity or reliability of the method. Without such population studies, it is impossible to assess the number of characteristics that must match in order to have any particular degree of confidence about the source of the impression.”

Previous Work

- Adair, et. al. (2007)¹: The Mount Bierstadt Study
 - 6 participants, 12 pairs of hiking type boots
 - 3.5 miles of hiking with each pair along same path
 - Variables well controlled
 - Study supports that “...accidental damage found on footwear outsoles is randomly produced.”
- Cassidy (1980)²:
 - 2 different studies using the heels of boots, total of 157 pairs
 - Heels manually applied

1. Adair, T.W., J. Lemay, A. McDonald, R. Shaw, R. Tewes, “The Mount Bierstadt Study: An Experiment in Unique Damage Formation in Footwear”, *JFI*, 57 (2), 2007, 199-205.
2. Cassidy, M. J., *Footwear Identification*, RCMP, 1980.

Scientific Method

- Observations
- Question/Hypothesis
- Experiment
- Evaluation
- Re-hypothesize, if necessary

Observations

- The process of wear produces marks on footwear outsoles.

Question/Hypothesis

- Are these acquired marks random?
- A possible hypothesis: Given that all variables are controlled, the same person wearing the same type of shoes along the same path for the same amount of time will reproduce the same types of acquired marks in the same position on each outsole.
- **PROBLEM**
 - Impossible to exactly reproduce the same path.

Hypothesis Restated

- Given that all variables are controlled as much as possible, the same person wearing the same type of shoes along a similar path for the same amount of time will reproduce different types of acquired marks in different position on each outsole.

Experiment

- 4 Pairs of Shoes (A-D)
- Participant 1 = Pairs A and B (Size 9)
- Participant 2 = Pairs C and D (Size 8)
- Pedometers
- Record Keeping
- Lots of Walking

Shoes

- Nike Air Courtballistec 2.1



Outsole Design

- Rubber Outsole



Toe



Heel



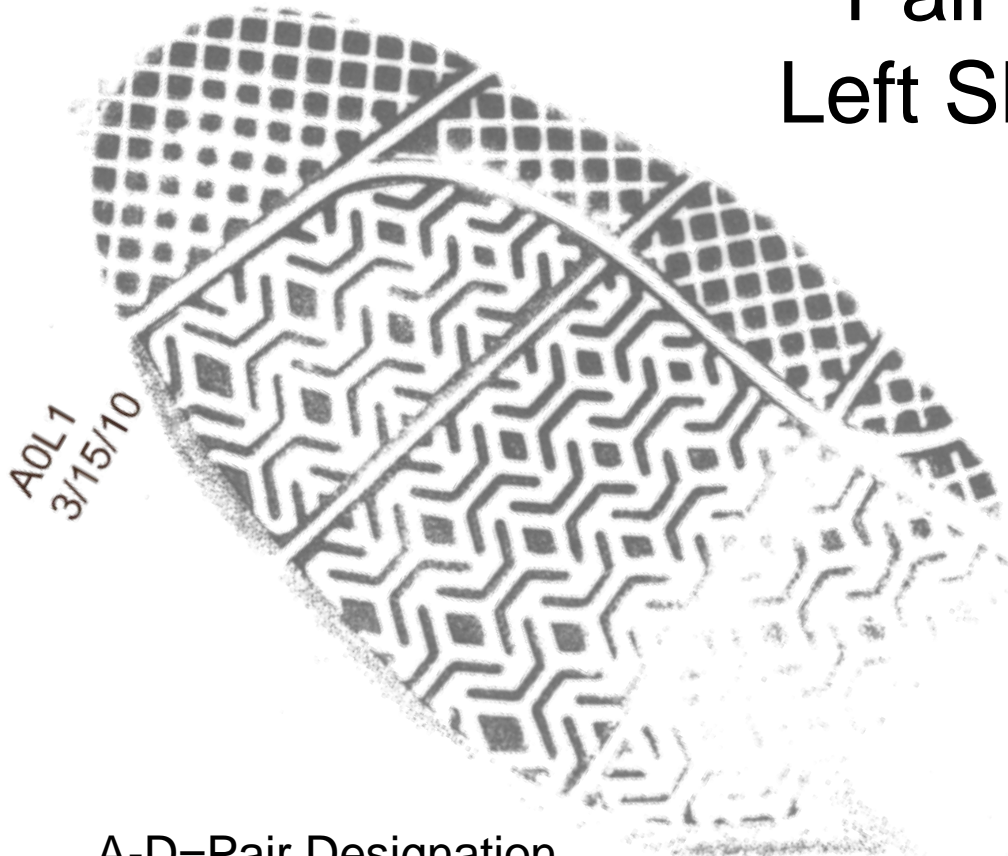
Statistics

- About 138,000 steps total for each pair of shoes (55 miles)
- About 64,000 steps (25 miles) outside on asphalt/cement/gravel (45% of total wear)
- About 250 hours of wear, sometimes sitting

Exemplars

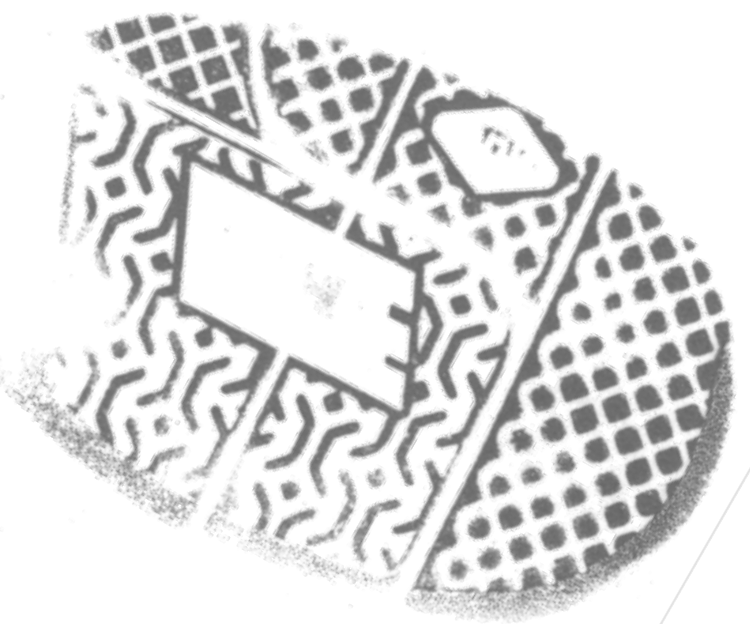
- Taken prior to any wear using Identicator and powder/adhesive lift methods
- Taken about every 4000 steps using Identicator

Pair A Left Shoe



A0L1
3/15/10

A-D=Pair Designation
0-35=Interval Number
L/R=Left or Right
1/2=Exemplar #



Procedure

- Outsole visually examined with oblique lighting
- Observed characteristics on outsole were then searched for on exemplar
- The exemplars were searched to see when the mark first appeared
- The characteristic was marked on the overlay
- When finished, overlays were overlaid

Grid Overlay



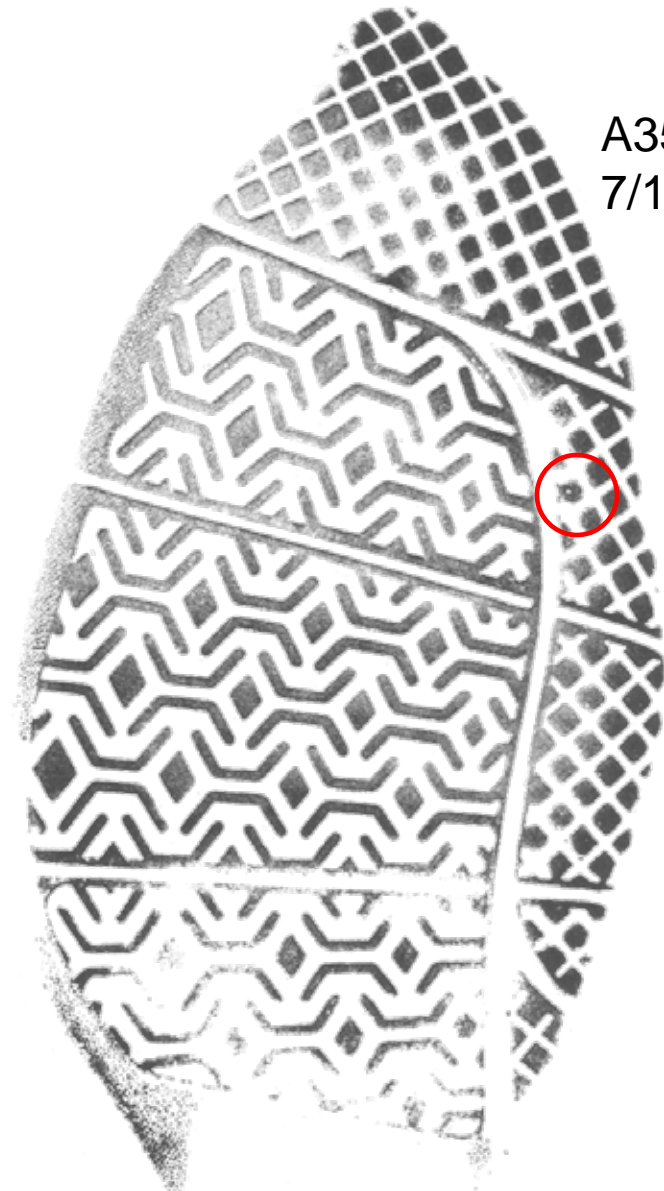
Pair A

Left Shoe Toe

A0L1
3/15/10



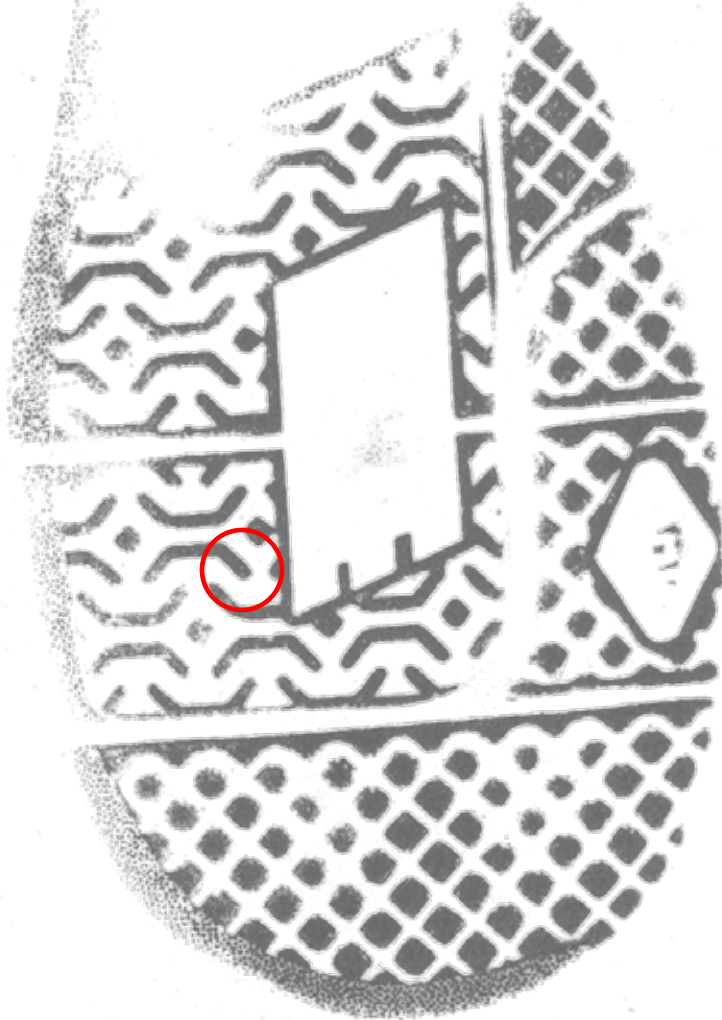
A35L1
7/14/10



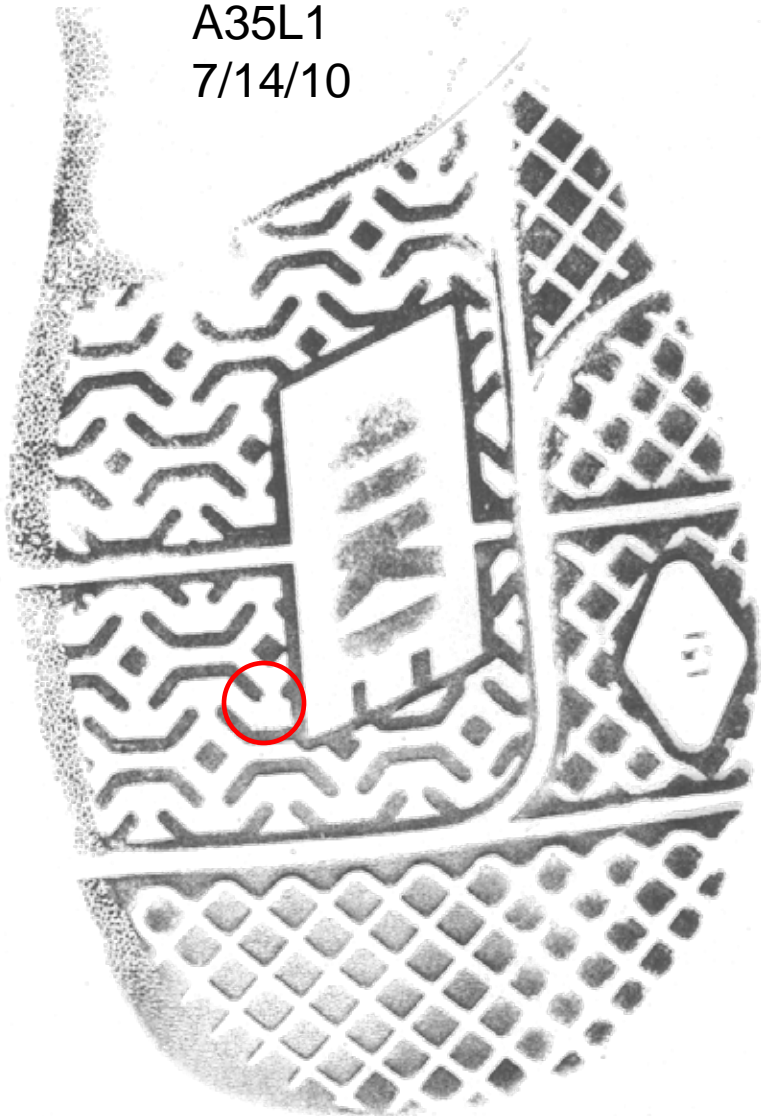
Pair A

Left Shoe Heel

A0L1
3/15/10

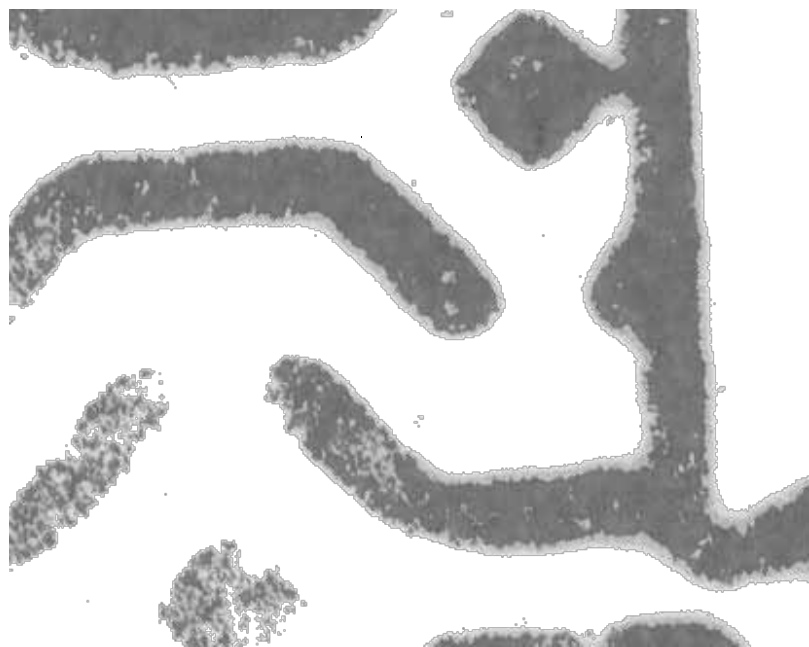


A35L1
7/14/10



Pair A

Left Heel Close-up



A0L1 Heel



A35L1 Heel

Left Shoe Heel



Pair A

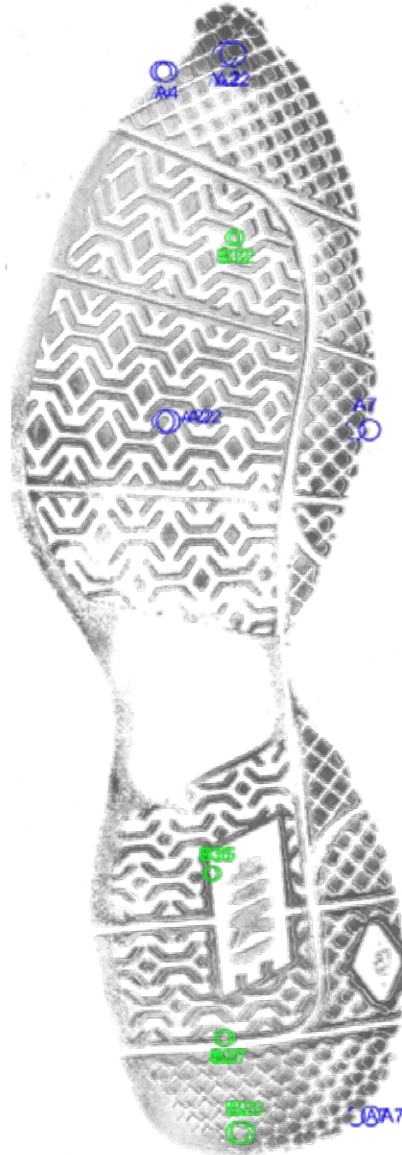


Pair B

Results – Left Shoes

- A – 5 marks (Intervals 4, 7, 7, 22, 22)
- B – 4 marks (23, 27, 32, 35)
- C – 10 marks (8, 14, 28, 30, 30, 32, 33, 33, 33, 35)
- D – 12 marks (11, 20, 21, 29, 29, 31, 32, 32, 33, 33, 33, 35)

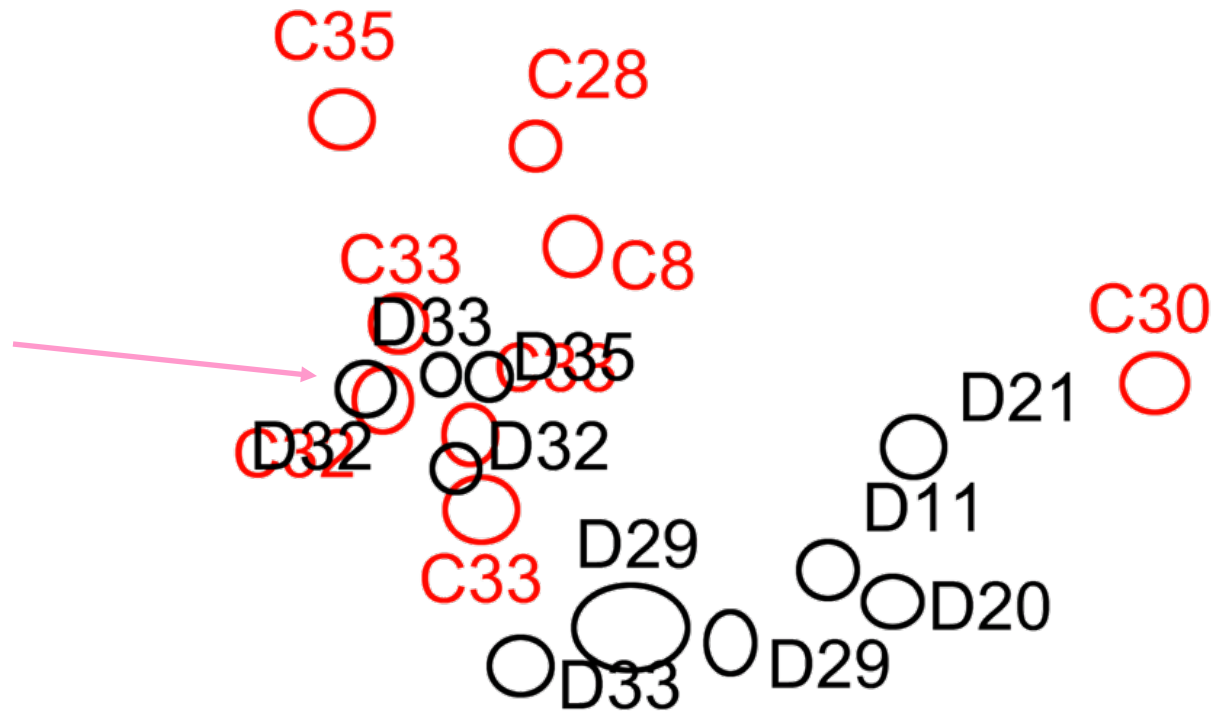
A-B Comparison



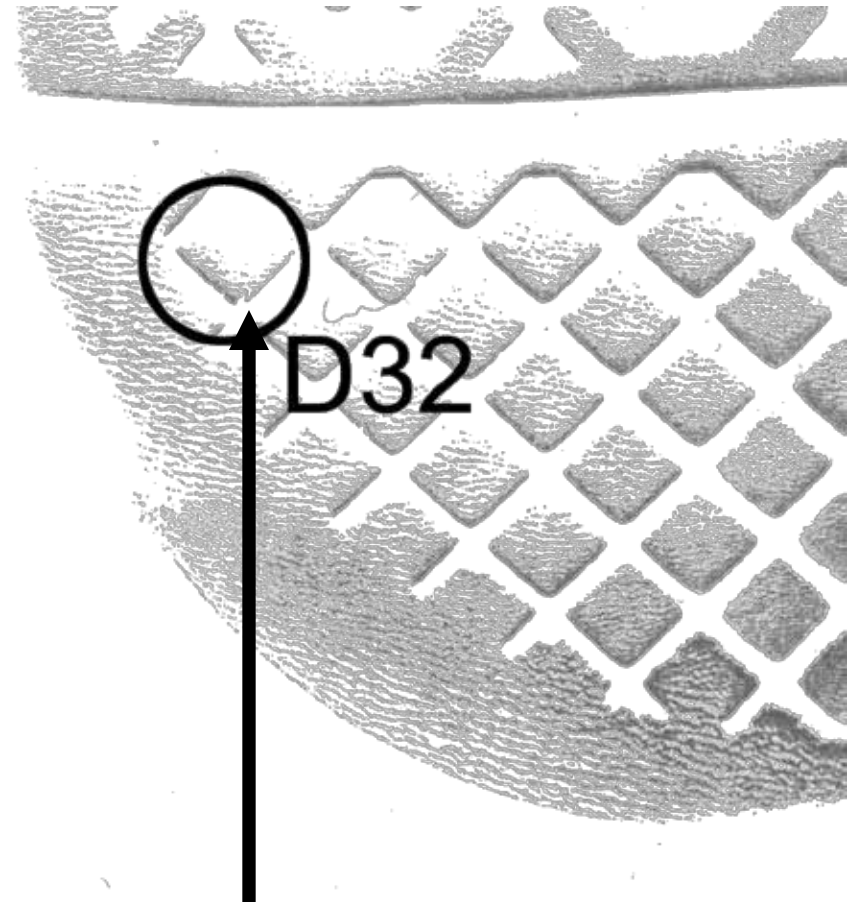
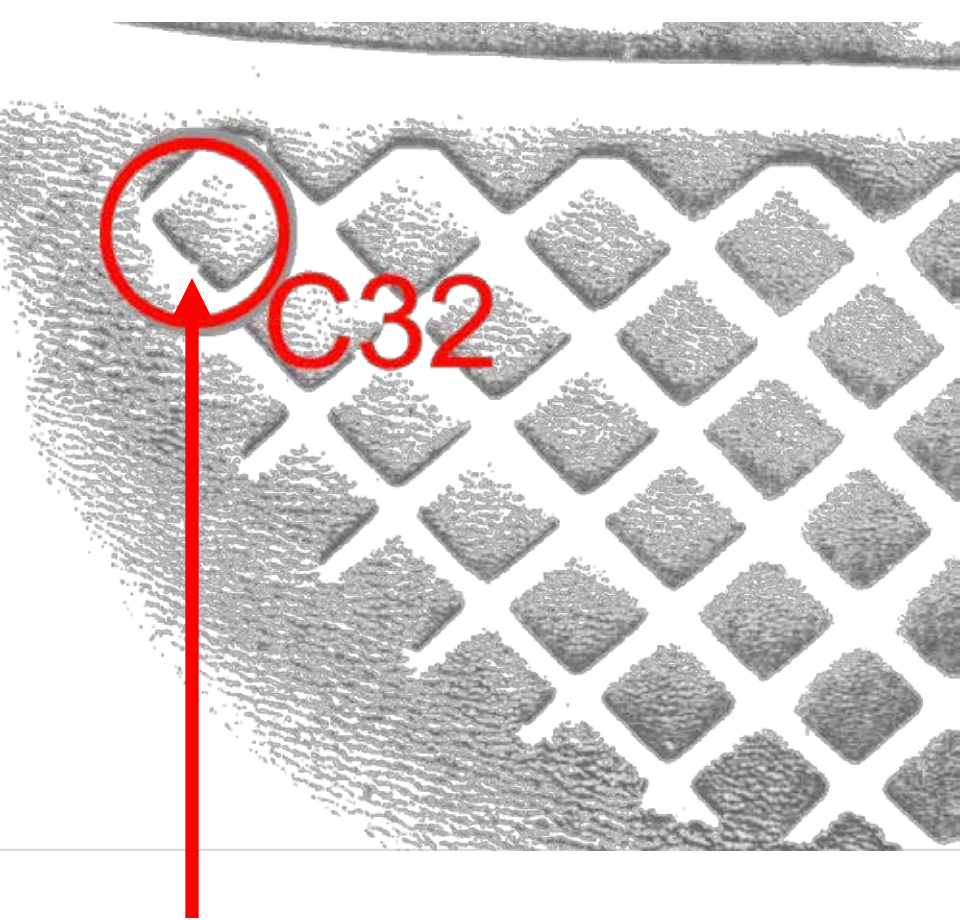
C-D Comparison



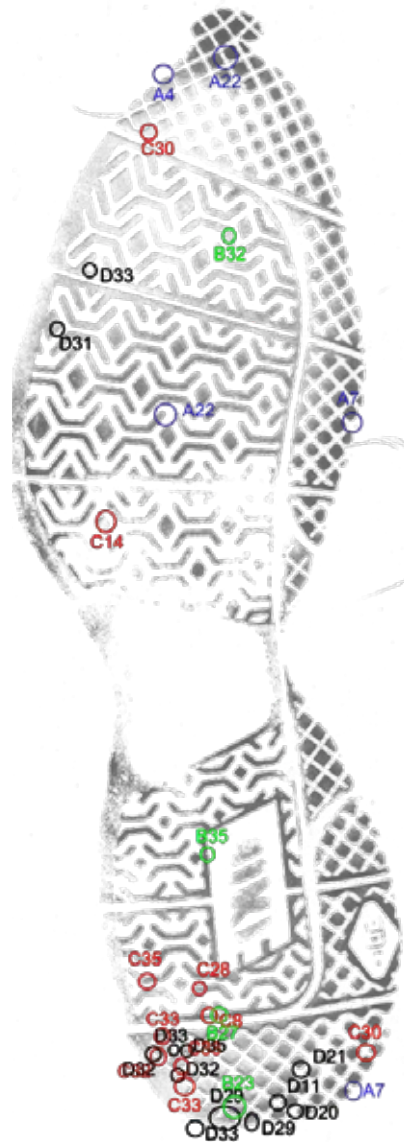
C-D Comparison



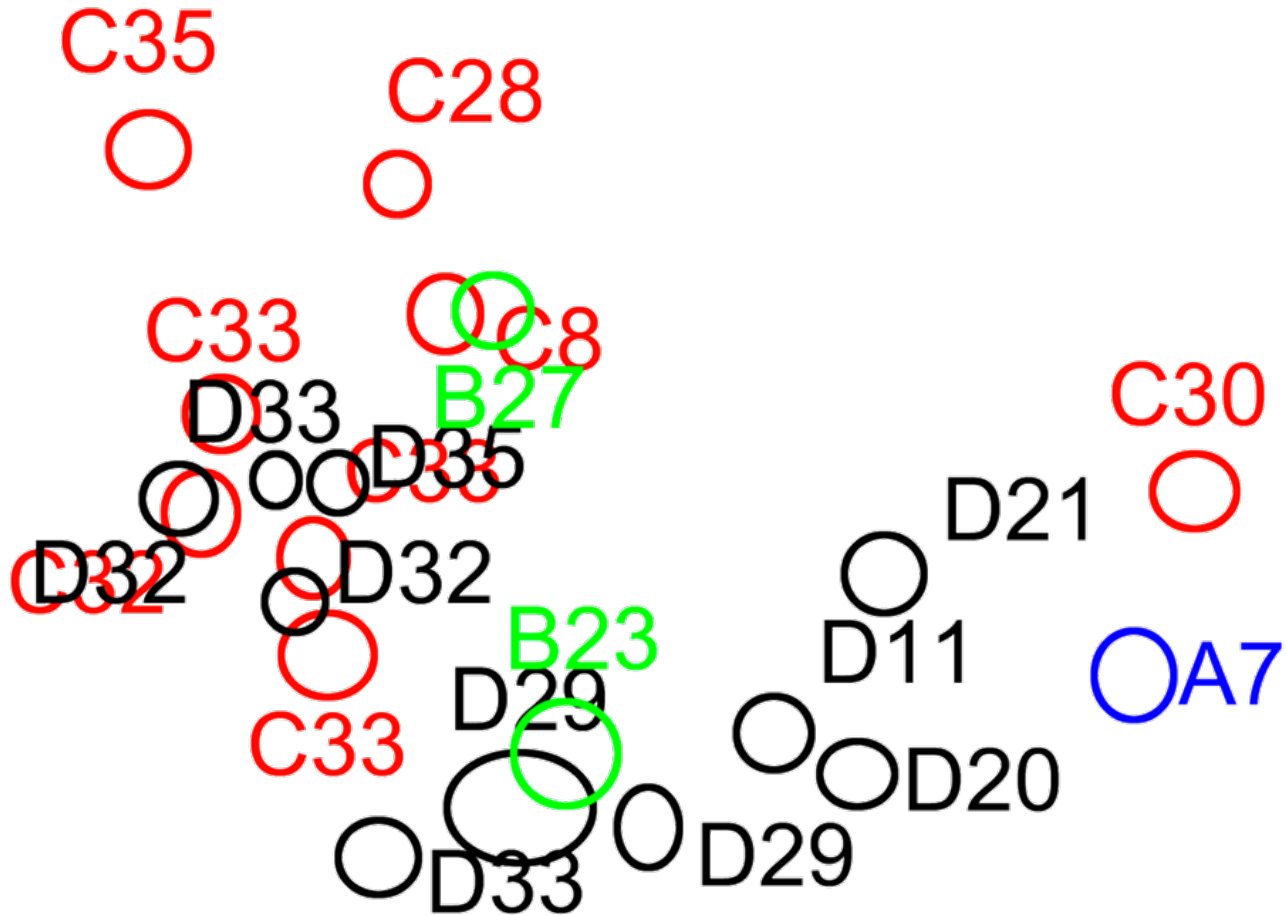
C32L vs D32L



All Left Shoes



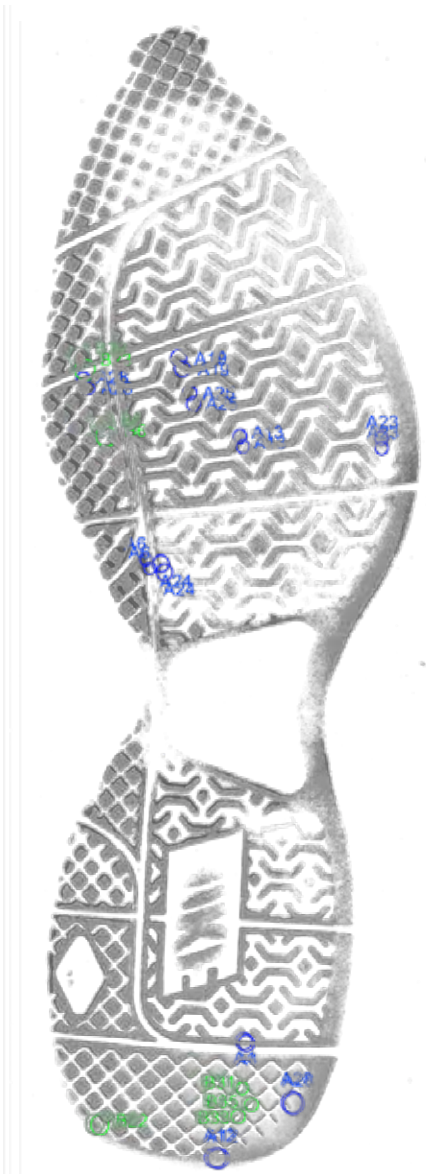
All Left Shoes



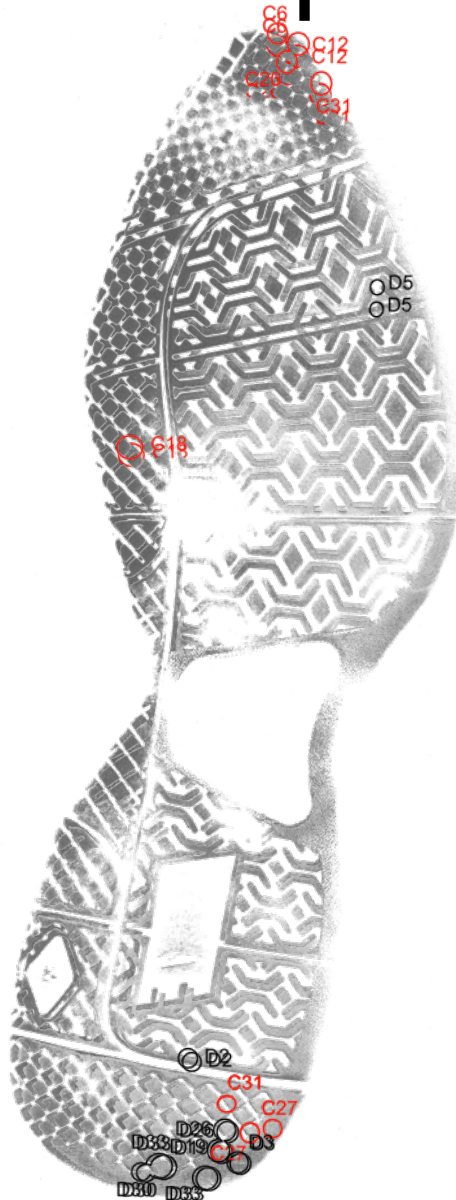
Results – Right Shoes

- A – 10 marks (4, 6, 12, 13, 19, 23, 24, 25, 28, 28)
- B – 6 marks (6, 22, 23, 31, 33, 35)
- C – 8 marks (6, 12, 20, 23, 27, 27, 31, 31)
- D – 7 marks (2, 3, 5, 19, 30, 33, 33)

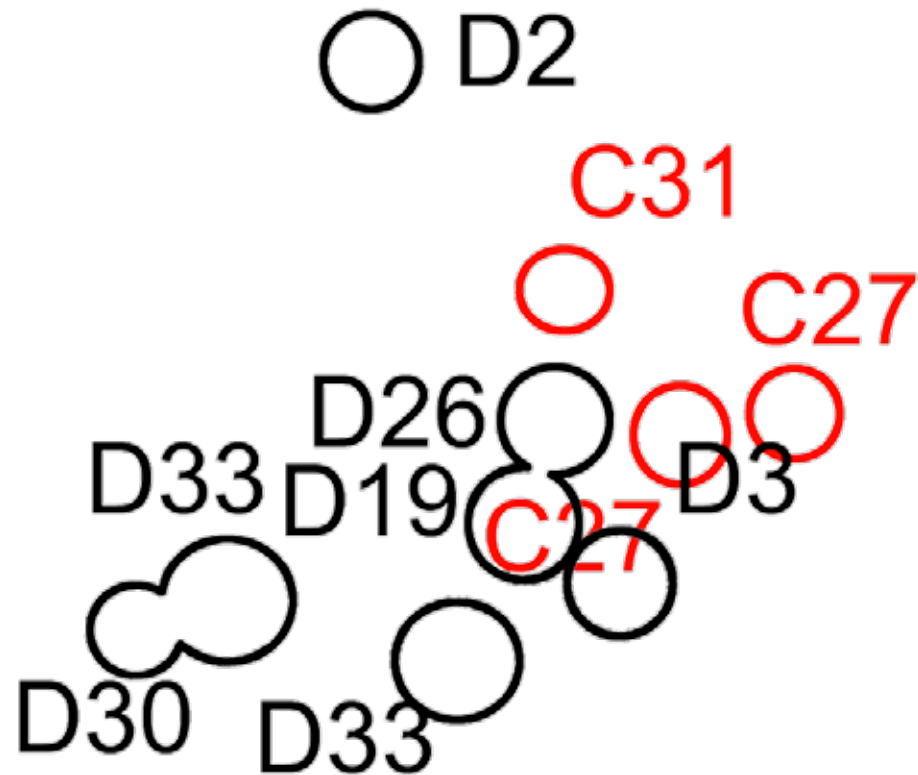
A-B Comparison



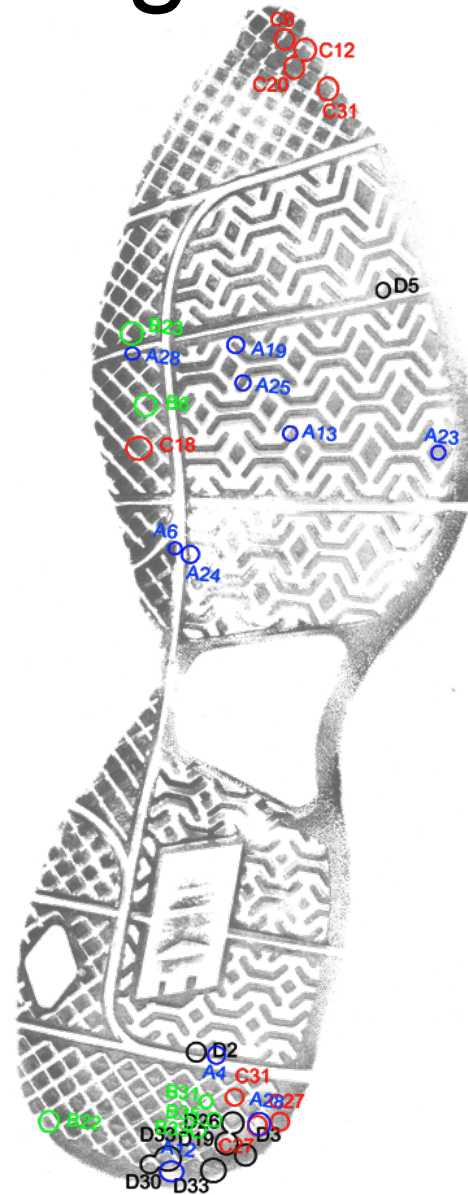
C-D Comparison



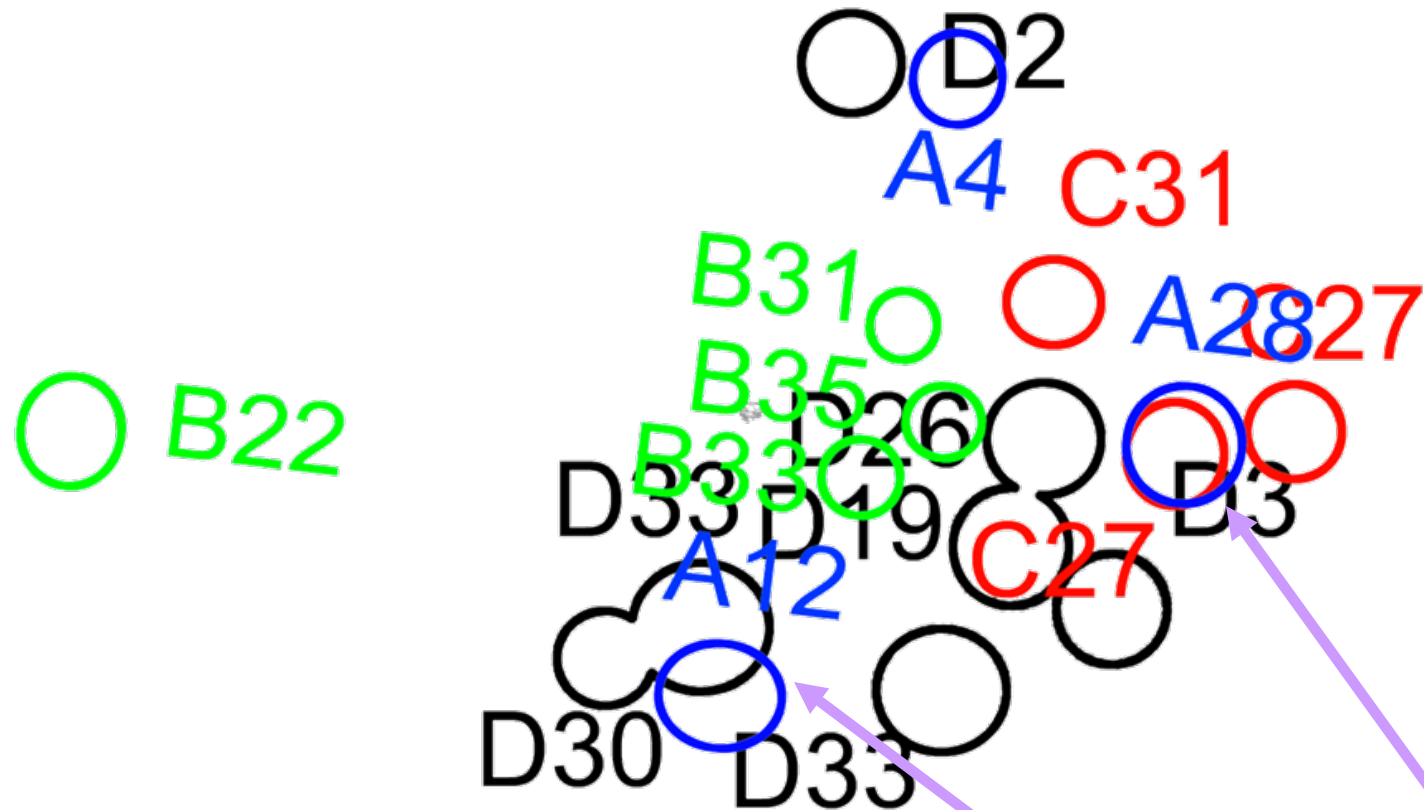
C-D Comparison



All Right Shoes

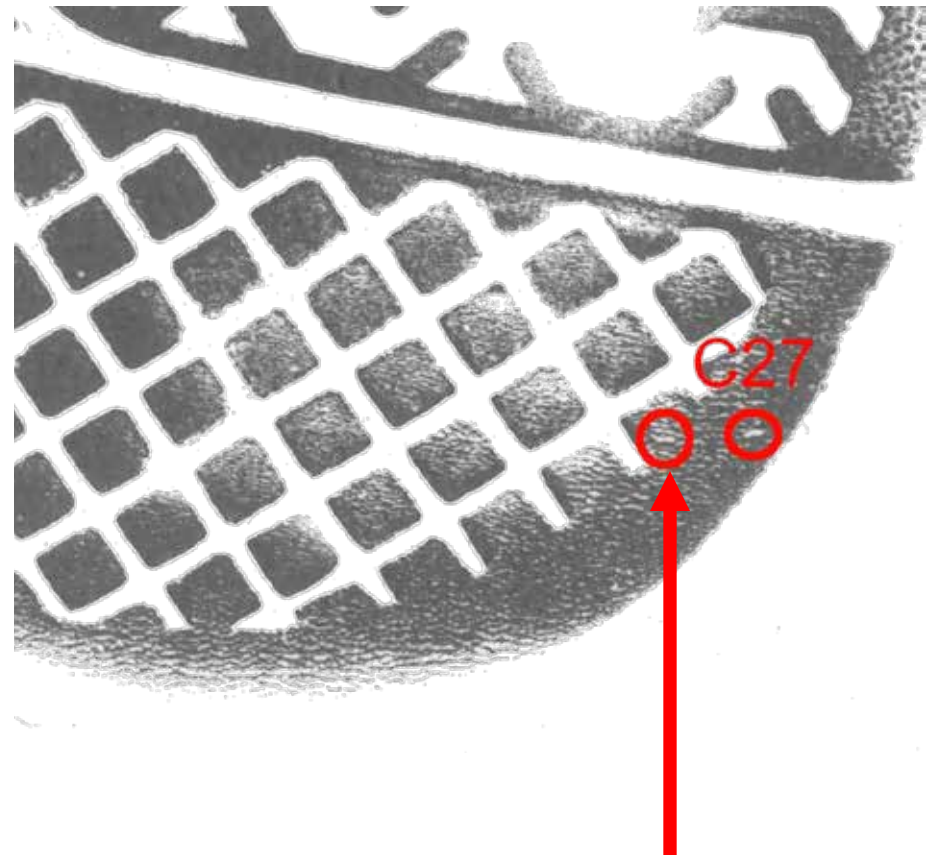
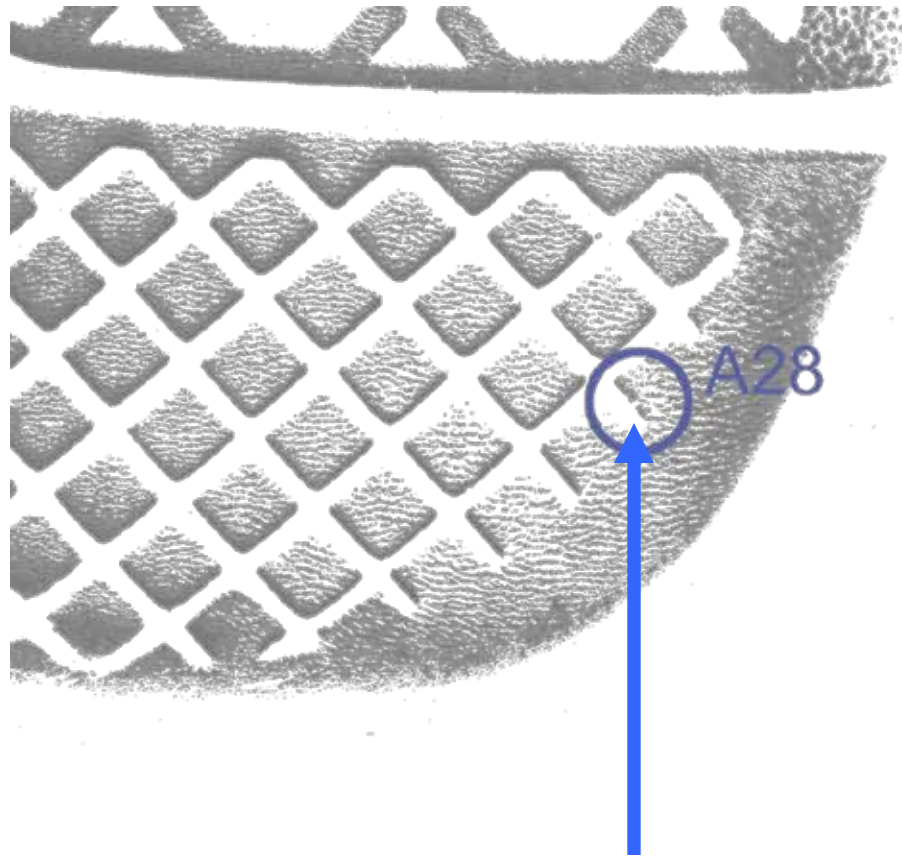


All Right Shoes



On Different Tread Elements

A28R vs C27R



Mark Intervals – All shoes combined

- 9 marks
 - 33 (Costco, Loop, and end of 84th)
- 4 marks each
 - 23 (Parking Lot, Loop, and end of 84th)
 - 31 (Parking Lot, Loop, and end of 84th)
 - 32 (End of 84th x 2)
 - 35 (Costco, Loop, and end of 84th)
- 3 marks each
 - 6 (Spaghetti Factory)
 - 22 (Loop and end of 84th)
 - 27 (Parking Lot, Loop, and end of 84th)
 - 28 (Parking Lot x 2 and end of 84th)
 - 30 (Parking Lot and end of 84th)

Results/Conclusions

- None of the acquired marks repeated on any of the shoe outsoles
- This study supports the conclusion that acquired marks are random and non-repeatable

What Else We Learned

- There are 200 steps to the copy machine
- Coworkers think its weird when you walk laps within the building
- It's a good thing to like your research partner when you have to take lots of long walks together

Challenges

- Limited to two participants because of the record keeping difficulties
- Vacations and furlough days limited activity outside of the lab
- Limited amount of acquired marks on outsoles during this time frame
- Actual footpath impossible to repeat

Future Work

- This experiment will continue with these pairs of shoes
- Different outsole materials should be evaluated
- More of these types of studies should be completed

Acknowledgments

- Mr. Herb Hedges and Nike for their generous donation of the shoes.
- The Oregon State Police Forensic Services Division for allowing the time to complete this study.