

Technical Note

The Mount Bierstadt Study: An Experiment in Unique Damage Formation in Footwear

*T. W. Adair*¹

*J. Lemay*²

*A. McDonald*³

*R. Shaw*³

*R. Tewes*⁴

Abstract: Randomly formed damage on footwear outsoles has appropriately been used to compare crime scene impressions to the known shoes of suspects, witnesses, and victims. In this study, the authors wore new, identical boots (two pairs) during a seven-mile hike. The authors attempted to control the major variables except the manner in which the outsole of the boot made contact with the ground. The results of this experiment support the use of these marks for the individualization of footwear and confirm their random formation through the use of the shoe by the wearer.

Introduction

The use of random damage characteristics has been reliably used in the comparison of known outsoles to questioned impressions found at crime scenes [1, 2]. These damage characteristics are formed through the use of the shoes while they are worn. The presence of these characteristics in both the known shoe and crime scene impression may allow the footwear examiner to individualize one shoe as having made an impression.

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¹ Westminster Police Department, Westminster, CO

² Weld County Sheriff's Office, Greeley, CO

³ Arapahoe County Sheriff's Office, Centennial, CO

⁴ Fort Collins Police Department, Fort Collins, CO

The authors hypothesized that these characteristics could be created during a single common activity, such as a hiking trip. It was further hypothesized that the characteristics would exist in sufficient numbers to individualize the shoes, even among participants wearing the same shoes and following the same general walking path under the same environmental conditions. By exposing the same manufactured shoes to the same environmental, topographical, and duration of use conditions, the authors hoped to test the premise that accidental characteristics would be created, allowing for the individualization of the shoes. To that end, this study was developed to answer the following questions:

1. Will random characteristics be created in sufficient numbers to allow for individualization by low- to medium-impact walking over relatively short distances?
2. Will these random characteristics share any common location or orientation with other characteristics found on outsoles exposed to the same testing conditions but worn by different persons?
3. Would two pairs of shoes worn by the same individual under the same physical conditions exhibit accidental characteristics allowing for individualization?

Materials and Methods

The Altitude II hiking boot from the Hi Tec Corporation was selected as the test shoe in this study (Figure 1). The Altitude II has a seam-sealed waterproof nubuc leather upper with a carbon rubber outsole. It also features a lightweight compression-molded midsole and steel shank. The finished weight of the shoe is about 21oz. Twelve pairs of boots were acquired from the company. The men's sizes were all 10.5 (US), and the women's sizes were 8, 9, and 10 (US). Each of the six participants (three men and three women) had two pairs of boots for the study. One pair was designated to be worn during the ascent and the other during the descent. The boots were not damaged prior to the study. Some boots were briefly worn on carpeting (indoors) prior to the study to break them in but were inspected prior to the hike to ensure that no damage had occurred. Photographs and black fingerprint powder transparency lifts were made of each shoe prior to and



Figure 1

Outsole of the Altitude II hiking boot from the Hi Tec Corporation.

immediately after the hike. One female participant was unable to make the initial hike and completed the hike with one of the authors a few weeks later. The environmental conditions were similar to those experienced by the previous group.

Mount Bierstadt in Colorado has an elevation of 14,065 feet and a trailhead beginning at 11,691 feet. The total hiking time was approximately 3.5 hours and the total distance traveled (round trip) was approximately 7 miles with a 2400-foot gain in elevation from trailhead to summit. Mount Bierstadt is ranked as an “easy” hike and was selected by the authors because it represented a popular destination and relatively low-impact hiking conditions. On July 31, 2005, the authors began their climb of Mount Bierstadt on Guanella Pass near Georgetown, Colorado. The trail is composed primarily of compacted groomed soil with randomly occurring larger rocks embedded in the surface mix. The last part (approximately 200-250 yards) of the trail is comprised of a large boulder field that requires slow and deliberate foot placement. Although the hike was expected to be fairly easy and completed in one day, unpredictable and rapidly changing weather conditions, commonly found at these high elevations, were encountered. The authors experienced a hailstorm lasting nearly the entire descent. Although the trail conditions became wetter during the descent, the compactness of the trail did not seem to differ significantly from the ascent.

Discussion

Shortly after completing the hike, the authors rephotographed all the boots and made transparent black powdered lifts. The boots were not worn between the completion of the hike and the documentation of the outsole conditions. The authors then examined the outsoles for the presence of the accidental characteristics. To assist in the examination of these boots, the individual outsole elements were given a numerical “address” from one to thirty-eight (Figure 2). Examiners noted the presence of each accidental mark and its address (location) on the outsole. The authors counted only the accidental marks that comprised sufficient size and shape to suggest that they would be represented in a crime scene impression under favorable conditions and could be used to individualize the boot. (This study did not seek to determine whether each and every accidental mark would be reproduced in a latent or crime scene impression, because

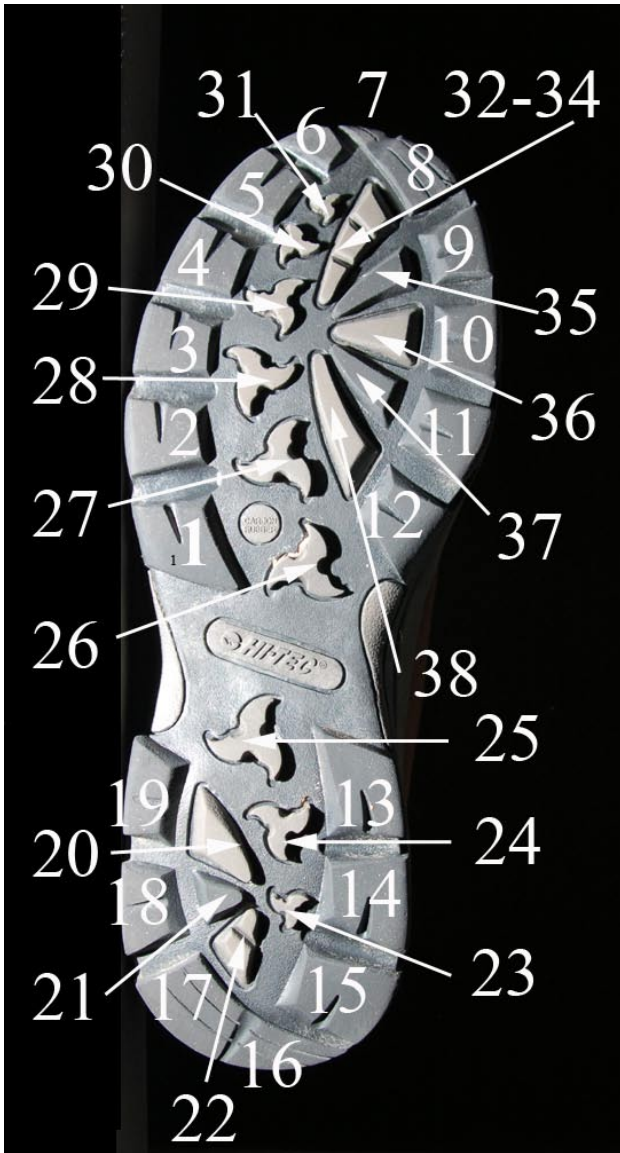


Figure 2

Outsole of the Altitude II hiking boot with “address” identifiers 1 to 38.

such findings would be predicated on a number of changing factors such as the transfer medium and the surface receiving the impression.) The men's and women's boots differed slightly in the number of outsole elements containing at least one accidental mark. On average, the men's boots contained accidental marks on 44% of the elements, whereas the women's boots contained marks on 33% of the outsole elements. Each male outweighed each female by at least 50 pounds, which may contribute to heavier footsteps, resulting in additional damage. Within the gender groups there was variation as well. One male had as few as 13% of the elements (representing five accidental marks on one boot) with accidental marks, whereas another male had one boot with 62% of the elements containing marks. (The first male subject is a long-time hiker and stated that he subconsciously avoids larger rocks and drop-offs on trails. This may help to explain the lower number on average for this male subject when compared to the other two.)

The outsoles were then compared to each other to determine whether they contained enough detail to be individualized. Each outsole did contain a sufficient number of accidental marks to allow for individualization and each outsole could easily be differentiated from the other outsoles in the study. Additionally, the transparent lifts were reversed and compared as well with the same results. This resulted in a comparison group of 24 outsoles (12 normal, 12 reversed) totaling 576 comparisons. Although significant differences in the physical size of outsoles would normally be sufficient to eliminate a questioned impression, the authors also verified the lack of corresponding damage in the same "address locations" on the outsole, regardless of their physical size differences. In other words, accidental marks found on address location #32 on a women's size 8 outsole were compared to any accidental marks found at the same address location on a men's size 10.5 outsole. No corresponding marks were found at any locations between the subject outsoles (normal or reversed) in this study.

Conclusion

The results of this study demonstrate the widely accepted proposition that the accidental damage found on footwear outsoles is randomly produced. This study attempted to eliminate as many variables contributing to the formation of these

accidental marks as possible. By using the same style of boots (in the same new condition), the same walking path, the same environmental conditions, and the same duration of use, the authors were able to eliminate all major contributing factors to the formation of these marks, aside from the subject's walking style and the random manner in which the outsole made contact with the micro-topography of the walking trail. In addition, the results of this study indicate that these accidental marks may be created by a single walking event, representing one of many changes occurring in the evolution of the damage and wear represented on the outsole. Similar studies should be conducted and reported to further test these findings under varied conditions.

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For further information, please contact:

Thomas W. Adair
Senior Criminalist
Westminster Police Department
9110 Yates Street
Westminster, CO 80031
303-430-2400 x 4269
tadair@ci.westminster.co.us

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