



# Individual human odor fallout as detected by trained canines<sup>☆</sup>



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## ABSTRACT

We tested the hypothesis that if odor fallout (the release of a human's odor onto an untouched object) in human subjects exists, then holding a hand above an absorbent will produce a detectable scent which will be subsequently matched in a detection test by trained canines. Scents were collected from seven males to sterile cotton absorbent squares. The left hand was used to get the control scent and the right hand served as the target scent. Each experimental subject was sitting; his left hand was laid down on a cotton square for 3 min. The right hand was held 5 cm above another cotton square for 3 min. The scent identification was done by two specially trained police German shepherds. These canines had routinely performed scent identification line-ups as part of criminal investigation procedures. Both canines performed 14 line-ups and correctly matched the collected scents of all test subjects. The results suggest the existence of human odor fallout, whereby a human scent trace is left by humans even if they do not touch an object.

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## 1. Introduction

The uniqueness and persistence of human scent and its usability for criminal evidence has been previously investigated [1–3]. Trained canines (*Canis familiaris*) have been used to track people and numerous studies have indicated that canines are able to differentiate humans by their scent [4–8]. This ability is the main reason why the usage of canines to match human scents collected from a crime scene, has reached widespread acceptance [1].

The source of human scent is the body. Historically, it was thought that human odor comes from dead skin cells alone [9]. However more recently, it has been shown that human odor is based also on various other complex components [1,10,11] such as heredity, environment, experience, diet and other lifestyle habits and genetic attributes [9,10].

The usage of human scent identification implies the assumption that every individual person has a specific individual scent

[9,12,13], which is constant over time [14]. Curran et al. [1] suggested that the human scent consists of three types of odors. The combination of these three parts contributes to the individuality and uniqueness of human scent. This finding is likewise inclusive of identical twins individual scents [15].

The scent identification line-up is a method widely used in European countries [16] such as, Hungary, the Czech Republic [18], and Russia [19] for more than 100 years [17,20]. Canines are trained to match the perpetrator's scent left on an object related to a crime [16,17]. A number of studies have shown that canines are even able to match human scents from different parts of the body [4,6,10,21]. Moreover, canines can recognize and match a given scent from objects with a person who had previously touched them [17,22,23]. However, there has been no study dealing with the investigation of natural scent fallout. Some authors have concluded that canines might be able to detect the presence of a human even in absence of a "track" [9], while still being able to trace human-laid trails [24]. Most and Brückner [25] made an attempt to check if canines are able to additionally follow trails made by humans walking on stilts. As the canines did not have a problem correctly following such trails, the authors hypothesized it was due to the presence of human odor falling out onto the trail. In their design, the authors subsequently used a constructed tracking wheel. Even when the trail did not contain any human scent, canines were still able to follow prints made by this wheel. The last

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test in their design was the creation of a trail from just the odor fallout of a human subject. The subject walked through a landscape to a special trapeze. He sat down on the trapeze and moved himself above the ground. The canines were able to track the scent on the ground of the walking subject, but could not continue tracking beyond the point from where the human subject remained above ground. The authors thus concluded that canines are not able to follow humans by their odor fall.

In our design, we tested the hypothesis that if odor fallout exists, then holding a washed hand above a cotton absorbent with no physical contact, will produce enough scent to be matched by a trained canine in the same way as when the absorbent was touched by the second hand of the same subject.

## 2. Materials and methods

Scents in this study were collected from seven male subjects 15–60 years old. Subjects were instructed to wash their hands under pouring water using the same fragrance-free soap (Bioderma Laboratoire Dermatologique) without any conserving substances. They let their hand dry freely without contact with any object or person.

Scents were collected onto sterile cotton absorbent squares (ARATEX™, Chluntex) sized 30 cm × 30 cm, which are normally used for criminal investigations in the Czech Republic [19]. The cotton squares were stored in new sterile glass jars with twist off lids. Samples were collected in the same room, time of day and by the same assistant. All experimental subjects opened the glass jar, pulled out the ARATEX™ cotton square and put it on the naked skin in the belly region for 20 min. Then the experimental subject washed his hands again and waited for them to dry off naturally. When the hands were dry, the scent from his hands was collected. The cotton square was laid down on a piece of foil to avoid its contamination. The left hand was used to get a control scent. The right hand was used as the target scent. Each experimental subject was instructed to sit with his left hand laid down on top of the cotton square for 3 min. His right hand was held 5 cm above the cotton square for 3 min. A total of 21 scent samples were collected from 7 subjects and divided into 3 groups by their origin (left hand – control; right hand – target; body – smeller).

The glass jars with collected scents samples were stored according to the procedure routinely used by police officers when collecting scent samples from suspects: i.e., the samples were stored in glass jars with carefully tightened twist-off lids. All glass jars were labeled with codes. They were stored at the police canine facilities in room temperature, with stable atmospheric moisture.

The scent identification was done by a pair of female German Shepherds handled by two police canine officers. Both of them were professionally trained police canines, certified as scent identification canines, which had passed their annual certification procedure. The canines had routinely performed scent identification line-ups as part of criminal investigation procedures at the regional police headquarters in Hradec Králové. During a scent identification procedure in police work, the canines sniff at a starting scent named “smeller” and search the line-up of odors for the control or target scent [15]. The two canines had been trained previously to match only the last scents they were let to sniff and pass those scents that were previously targets. Due to this design, there was no need for distracting scents, as every scent in the line-ups was sooner or later either the target or control scent.

During the scent identification procedure, the seven glass jars without lids, containing individually either the control or target scents, were put in a line-up. In the first part of the experiment, canines performed a matching task on the control scents. The canine sniffed a smeller scent and was sent to match it with the scent from the left hand of the same subject. This was done seven times, using smellers from different subject, until all samples (C1–C7) were identified in the matching procedure.

In the second part of the experiment, the canine handlers made a line-up of the target scents (T1–T7). The matching procedure was the same as in the line-up with control scents. During all scent identification procedures, the handlers were blind to the position of each control and target scent in the line-up and expected results. Canine handlers were asked to write an official report on the outcome of the scent identification line-ups as they would with a real police investigation.

### 2.1. Ethics statement

This study was carried out in strict accordance with the recommendations in the Guide for the Care and Use of Animals of the Czech University of Live Sciences Prague and was conducted in accordance with Czech Central Committee for Protection of Animals number (MŠMT 26663/2010-30, 7/2010).

## 3. Results

The two female German Shepherd canines performed 14 line-ups and correctly matched the scents of all tested persons

(Binomial exact test,  $n = 28$ ,  $P = 0.000000007$ ). A statistical analysis could not be made for the comparison of matched scents between the left and right hands because there was no variation between them.

## 4. Discussion

The findings of our study show a statistically significant support of the hypothesis that odor fallout from humans exists and is individually recognized by trained canines. It was shown that human contact with a given object is not necessary in subsequent detection of that incidental scent left behind; it seems human scent is identifiable even if the source of the scent is above that object. Although the amount of odor that would enable detection has yet to be specified, these results demonstrate that human scent is able to be distributed on objects 5 cm away without any physical contact with the object and still be accurately matched by trained canines. The results could bring new possibilities in the collection of criminal evidence of human scent traces with further research needed to determine the full extent of this phenomenon.

As shown previously, a well trained canine which is made to detect a scent sample is crucial in these types of studies [15]. In the other known study dealing with this phenomenon which suggested that canines could not follow tracks created solely by individual human fall-out [25], was most likely realized with canines that had been trained to follow any and all human tracks laid down by humans walking in a terrain. Thus, these types of canines were not trained to solely follow individual human scent, but rather a mixture of individual human scent, odor of shoe soles, crushed vegetation, etc. In contrast, the canines in our study were trained and routinely used in scent identification line-ups for law enforcement duty. Further research would need to determine the exact height of the hand held above the cotton square as the threshold for canine identification ability, together with the duration necessary of a human subject's presence to activate scent fall-out and subsequent identification.

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